

**Nkurenkuru**  
ECOLOGY & BIODIVERSITY

**WAAI KRAAL QUARRY NEAR  
BEAUFORT WEST, WESTERN  
CAPE PROVINCE**

**BOTANICAL STUDY  
AND  
ASSESSMENT**

**Version: 2**

**Date: 15<sup>th</sup> February 2021**

**Author: Gerhard Botha**

**PROPOSED WAAI KRAAL AGGREGATE AND GRAVEL MINE**  
**NORTH-WEST OF BEAUFORT WEST, WESTERN CAPE**  
**PROVINCE**

**Report Title:** Botanical Study and Assessment

**Authors:** Mr. Gerhard Botha

**Project Name:** Proposed Waaï Kraal Aggregate and Gravel Mine north-west of Beaufort West, Western Cape Province

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## I. DECLARATION OF CONSULTANT'S INDEPENDENCE

- » act/ed as the independent specialist in this application;
- » regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- » do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- » have and will not have any vested interest in the proposed activity proceeding;
- » have disclosed, to the applicant, EAP and competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- » have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- » am aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

### REPORT AUTHORS

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November 2020

**Gerhard Botha** *Pr.Sci.Nat* 400502/14 (Botanical and Ecological Science)

## II. STATEMENT OF WORK

- » This study has been executed in accordance with and meet the responsibilities in terms of:
- NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326);
  - The "newly" Gazetted Protocols 3(a),(c) and (d) in terms of Section 24(5)(a) and 24(5)(h) of NEMA (Published on the 20th of March 2020);
  - The Terrestrial Plant Species Protocol published in GN NO. 1105 of 30 October 2020;

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Refer to Appendix 3 for curriculum vitae, Appendix 4 for relevant work experience and Appendix 5 for SACNASP Registration.

### III. LIST OF ABBREVIATIONS:

<b>CARA:</b>	Conservation of Agricultural Resources Act 43 of 1983
<b>CBA:</b>	Critical Biodiversity Area
<b>CITES:</b>	Convention on International Trade in Endangered Species of Wild Fauna and Flora
<b>CR:</b>	Critically Endangered (threat status)
<b>DAFF:</b>	Department of Agriculture, Forestry and Fisheries
<b>DEA:</b>	Department of Environmental Affairs
<b>DENC:NC:</b>	Department of Environment and Nature Conservation: Northern Cape Province
<b>DWS:</b>	Department of Water and Sanitation
<b>NCNCA:</b>	Northern Cape Nature Conservation Act (Act No. 9 of 2009)
<b>DDD:</b>	Data Deficient – Insufficient Information (threat status)
<b>DDT:</b>	Data Deficient – Taxonomically Problematic (threat status)
<b>NFA:</b>	Nation Forest Act 1998; No 84 of 1998
<b>DEA:</b>	Department of Environmental Affairs
<b>EA:</b>	Environmental Authorisation
<b>ECO:</b>	Environmental Control Officer
<b>EIA:</b>	Environmental Impact Assessment: EIA regulations promulgated under section 24(5) of NEMA and published in Government Notice R. 543 in Government Gazette 33306 of 18 June 2010
<b>EI:</b>	Ecological Infrastructure
<b>EIS</b>	Ecological Importance and Sensitivity
<b>EMPr:</b>	Environmental Management Programme
<b>EN:</b>	Endangered (threat status)
<b>ESA:</b>	Ecological Support Areas
<b>EX:</b>	Extinct (threat status)
<b>EW:</b>	Extinct in the Wild
<b>FEPA:</b>	Freshwater Ecosystem Priority Area
<b>FW:</b>	Facultative wetland species – usually grow in wetlands (67 – 99% occurrence) but occasionally found in non-wetland areas
<b>GIS:</b>	Geographical Information System
<b>CIS:</b>	Conservation Important Species (species listed within IUCN and South African Red Data Lists or that are protected within relevant international, national and provincial legislation)
<b>GPS:</b>	Global Positioning System
<b>IAPs:</b>	Invasive Alien Plants
<b>IP:</b>	Invasive Plant (indigenous or alien)

<b>LC:</b>	Least Concern
<b>LT:</b>	Least threatened
<b>LFA:</b>	Landscape Functional Analysis (Tongway and Hindley 2004)
<b>NFA:</b>	National Forest Act 84 of 1998
<b>NE:</b>	Not Evaluated (threat status)
<b>NEMA:</b>	National Environmental Management Act 107 of 1998
<b>NEM:BA</b>	National Environmental: Biodiversity Act (Act No. 10 of 2004)
<b>NFEPA:</b>	National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2011)
<b>NT:</b>	Near Threatened (threat status)
<b>NWA:</b>	National Water Act No.36 of 1998
<b>OW:</b>	Obligate wetland species
<b>PES:</b>	Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting a change from its reference condition
<b>RE:</b>	Regionally Extinct
<b>SANBI:</b>	South African National Biodiversity Institute
<b>TOPS:</b>	Threatened and Protected Species in terms of section 56 of the National Environment: Biodiversity Act (NEM:BA) of 2004 (Species list as published within Gazette No. 30568, 14 December 2007)
<b>VU:</b>	Vulnerable (threat status)

#### IV. LIST OF DEFINITIONS:

**Accelerated soil erosion:** Soil erosion induced by human activities.

**Acceptable cover:** An acceptable cover shall mean that not less than 40% (in regions receiving less than 400 mm rain per annum), of the area rehabilitated and/or planted, shall be covered with grass and other species and that there shall be no bare patches of more than 500 cm in maximum dimension.

**Alien:** originating from another country or continent and originally different environment, commonly used to describe plants that are not indigenous to South Africa and have become problematic (spreading rapidly, threatening existing biodiversity)

**Allelopathic components:** one or more biochemical compound produced by a plant and released through leaf litter or roots that suppresses the growth, survival, and reproduction of other surrounding vegetation

**Alluvium soils:** Sedimentary material found in regions fringing river courses and composed of detrital matter transported and deposited by the river.

**Bare soil:** Un-vegetated soil surface, unaltered by humans

**Biodiversity:** The wide variety of plant and animal species occurring in their natural environment (habitats). The term encompasses different ecosystems, landscapes, communities,

populations, and genes as well as the ecological and evolutionary processes that allow these elements of biodiversity to persist over time.

**Biome:** A broad ecological spatial unit representing major life zones of large natural areas, and defined mainly by vegetation structure, climate as well as major large-scale disturbance factors (such as fire) (after Low & Rebelo, 1998).

**Bushveld:** A local regional term translated from the Afrikaans 'bosveld' and generally applied to various forms of savanna vegetation south of the miombo belts in southern Africa. In regional terms (Central Bushveld), used for the elevated plateaus between Pretoria in the south and Limpopo River in the north.

**Bush encroachment:** means stands of plants of the kinds specified in CARA Table 4, where individual plants are closer to each other than three times the mean crown diameter

**Catchment:** A catchment is an area where water is collected by the natural landscape. In a catchment, all rain and run-off water eventually flow to a river, wetland, lake or ocean, or into the groundwater system.

**Calcareous:** Pertaining to a soil or rock containing calcium carbonate, or related minerals, so that it effervesces (bubbles of CO<sub>2</sub>) when treated with acid. Usually formed from shells or chemical precipitation, these soils and rocks tend to have a coastal distribution (modified after Low & Rebelo, 1998)

**Calcrete:** A rock formed in the soil profile at the water table when calcium carbonate accumulates and cements particles together to form a hard rock band (Low & Rebelo, 1998)

**Chert:** Cryptocrystalline quartz of organic or inorganic origin. Also, the rock formed by the precipitation of this material, which can form bands or layers of nodules in sedimentary rocks

**Climax:** That vegetation type or plant community structure that occurs at the end of the seral cycle. The climax communities may not be the final endpoint of the succession: frequent or even rare events, such as fire, frost, harvesting, or hurricanes, may hold the communities in a stable subclimax indefinitely (Low & Rebelo, 1998)

**Compacted soil surface:** A soil surface that has been hardened by an outside source, causing the soil to be more compacted than the surrounding area.

**Conservation:** The safeguarding of biodiversity and its processes (often referred to as Biodiversity Conservation).

**Conservation Important Plant:** Any plant species that are protected within relevant international, national and/or provincial legislation and any species that is listed within the Red List of South African plants (version 2017.1).

**Container plants:** Container plants include all vegetation that is bought or supplied in acceptable containers from nurseries or vegetation lifted out of their natural position and placed in containers.

**Decimal degrees:** Degrees of latitude and longitude expressed in decimal format rather in degrees, minutes and seconds.

**Desirable end state:** the future condition or target on which the rehabilitation is designed and that will serve later as a basis for rehabilitation success evaluation. This can be based on a reference site or modeled according to available information on historic vegetation

**Ecotone:** A zone in which two or more vegetation types or ecosystems merge. These areas may be rich in species from both systems or may occur as species-poor fringes.

**Ecosystem Goods and Services:** The goods and benefits people obtain from natural ecosystems. Various different types of ecosystems provide a range of ecosystem goods and services. Aquatic ecosystems such as rivers and wetlands provide goods such as forage for livestock grazing or sedges for craft production and services such as pollutant trapping and flood attenuation. They also provide habitat for a range of aquatic biota.

**Ecological rehabilitation:** The process of assisting the recovery of a degraded or damaged ecosystem in a trajectory that renders the ecosystem fully functional, stable, and able to develop further, but not necessarily returning to the original historic state.

**Ecological restoration:** The process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed, in a trajectory that ultimately returns the ecosystem to its natural successional stage.

**Ecosystem:** The combination of biota within a given area, together with a suitable environment that sustains the biota and the interactions between biota. It can have a spatial unit of any size but shows some degree homogeneity as far as structure, function and species composition is concerned. Small-scale ecosystems typically link up to larger-scale ecosystems and all contribute to the ecosystem function and services at the landscape-scale.

**Endemic:** Refers to a plant, animal species or a specific vegetation type that is naturally restricted to a particular defined region (not to be confused with indigenous). A species of animal may, for example, be endemic to South Africa in which case it occurs naturally anywhere in the country, or endemic only to a specific geographical area within the country, which means it is restricted to this area and grows naturally nowhere else in the country.

**Ephemeroïd:** Referring to the life-form of a perennial plant that makes occasional appearances above-ground and maintains perennating organs underground (e.g. bulbous plants)

**Establishment of grass:** All procedures necessary to produce an acceptable cover of grass on an area.

**Establishment Period:** The Establishment Period is defined as the period beginning from the actual planting or placing of vegetation until three months thereafter, unless otherwise specified or unless grass cover is unacceptable or unless plants have not taken.

**Extinction debt:** is a concept that describes the future extinction of species due to events in the past. Extinction debt occurs because of time delays between impacts on a species, such as destruction of habitat or reduction of population size, and the species' ultimate disappearance.

**Floristic Classification:** Referring to the use of plant species composition (flora) as a criterion for characterising or classifying vegetation



**Forb:** A plant without secondary thickening (i.e. non-woody), usually living for only one or two seasons

**Function/functioning/functional:** Used here to describe natural systems working or operating in a healthy way, as opposed to dysfunctional, which means working poorly or in an unhealthy way.

**Geophytic:** resprouting during the growing season from an underground storage organ such as bulbs, corms, tubers or rhizomes, and dying back completely during unfavourable seasons

**Geoxylic Suffrutex:** A plant with annual or short-lived woody above-ground shoots sprouting from a massive or extensive, perennial, underground stem

**Graminoid:** Pertaining to an herbaceous growth form characterised by a 'grass-like' appearance (tufted growth, usually long and narrow leaves, secondary root system) and including plants such as grasses, restios, sedges, and rushes.

**Grassland:** Vegetation dominated by grasses (or graminoids) usually with a single-layered structure and sometimes with an open, woody plant cover.

**Habitat:** The general features of an area inhabited by animal or plant which are essential to its survival (i.e. the natural "home" of a plant or animal species).

**Indigenous:** refers to a plant or animal that occurs naturally in the place in which it is currently found

**Invasive plant:** a kind of plant which has under section 2 (3) of CARA been declared an invader plant, and includes the seed of such plant and any vegetative part of such plant which reproduces itself asexually

**Intact:** Used here to describe a natural environment that is not badly damaged, and is still operating healthily.

**Koppie:** Small hill or hillock, an Afrikaans term adopted by South African English

**Landscape:** Consists of a mosaic of two or more ecosystems that exchange organisms, energy, water, and nutrients.

**Land Type:** Map unit denoting land, mappable at 1:250 000 scale, over which there is a marked uniformity of climate, terrain form and soil pattern.

**Mitigate/Mitigation:** Mitigating impacts refers to reactive practical actions that minimize or reduce in situ impacts. Examples of mitigation include "changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites". Mitigation actions can take place anywhere, as long as their effect is to reduce the effect on the site where a change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).

**Nursery conditions:** These are the necessary conditions to maintain the healthy growth of rescued and/or container plants. This includes protection of such plants against wind, frost, direct sunlight, pests, rodents, diseases, and drought. It also includes the provision of suitable water, fertilizer and any other measures required to maintain the container plants.

**Period of Maintaining:** The Period of Maintaining is defined as the period following directly after the Establishment Period until the end of the Period of Maintenance for the whole Contract as defined in the General Conditions of Contract unless otherwise specified.

**Regic Soils:** Pertaining to a blanket of soil, usually sand, which has been deposited over another soil or rock, and which has not yet had time to develop profiles or layers

**Plagioclimax community:** An area/habitat/plant community in which anthropogenic (human) influences have prevented the ecosystem from developing further. The ecosystem may have been stopped from reaching its full climax or deflected towards a different climax by activities such as long-term ploughing, deforestation, burning, grazing and trampling by domestic animals, etc.

**Revegetation:** The process of establishing a vegetative cover on exposed soils, regardless of species composition or structure, as long as the species are non-invasive and their presence will not impede the gradual process of ecological rehabilitation or –restoration.

**Risk:** A prediction of the likelihood and impact of an outcome; usually referring to the likelihood of a variation from the intended outcome.

**Savanna:** Typically, vegetation with a grass-dominated herbaceous layer and scattered low to tall trees. It includes the closed woodland and open woodlands of Edwards (1983) with a tree cover less than 75% and generally greater than 1%

**Savannoid / Savanna grasslands:** Pertaining to open wooded grassland structurally similar to savanna, but from climatic reasons not belonging to the Savanna Biome. Savannoid vegetation is encountered within temperate zones.

**Soil Erosion:** is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of inter alia chemical processes and or physical transport on the land surface.

**Scarifying:** To roughen the surface of soil as preparation for seeding or topsoil addition.

**Succession:** A series of stages in which different plants and animals colonise an area following some kind of disturbance. The final stage of the succession is called the 'climax', but various disturbances may prevent the vegetation from attaining its potential climax

**Thornveld:** A woodland savanna dominated by trees with thorns, mainly Acacia species.

**Threatened Ecosystem:** In the context of this document, refers to Critically Endangered, Endangered and Vulnerable ecosystems.

**Threat Status:** Threat status (of a species or community type) is a simple but highly integrated indicator of vulnerability. It contains information about past loss (of numbers and/or habitat), the number and intensity of threats, and current prospects as indicated by recent population growth or decline. Any one of these metrics could be used to measure vulnerability. One much-used example of a threat status classification system is the IUCN Red List of Threatened Species (BBOP, 2009).

**Vegetation structure:** The horizontal, vertical and temporal arrangement of vegetation, i.e. spatially explicit, e.g. layers, patches, etc.

**Vegetation texture:** The composition of the vegetation in terms of species, growth forms, life forms, leaf morphological types, etc.

**Watercourse:** Means a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake or dam into which, or from which, water flows: and any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act, 1998).

**Wetland:** Refers to land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (National Water Act, 1998).

**WGS84:** Abbreviation of 'World Geodetic System of 1984'. A geocentric datum and geographical coordinate system created by the United States military and in world-wide use (ESRI 2006).

**Trimming:** To neatly round off the levels of existing or previously shaped earthworks to blend in with the levels of other earthworks, constructed works, or natural landforms.

**Transformation:** The conversion of an ecosystem to a different ecosystem or land use type.

**Topsoil:** uppermost layer of soil, in natural vegetation maximally 30 cm, in cultivated landscapes the total depth of cultivation, containing the layer with humus, seeds, and nutrients. Topsoils that are applied to landscapes to be rehabilitated must be free of refuse, large roots and branches, stones, alien weeds and/or any other agents that would adversely affect the topsoils suitability for re-vegetation.

**White grass:** Veld management term for (usually) tussock grasses (*Stipagrostis*, *Aristida*) turning veld into white plains through their conspicuous plumage of hairs on the seeds at the state of ripening and dispersal.

**Weed:** a plant that grows where it is not wanted, and can, therefore, be an indigenous or alien species. An unwanted plant growing in a garden is just called a weed, but the 198 listed IPs are called "declared weeds and invaders".

(Coetzee 2005, Clewell et al. 2005, SER 2004)

## TABLE OF CONTENTS

<b>WAAI KRAAL QUARRY NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE .....</b>	<b>0</b>
<b>I. DECLARATION OF CONSULTANT’S INDEPENDENCE .....</b>	<b>I</b>
<b>II. STATEMENT OF WORK .....</b>	<b>II</b>
<b>III. LIST OF ABBREVIATIONS:.....</b>	<b>III</b>
<b>IV. LIST OF DEFINITIONS:.....</b>	<b>IV</b>
<b>1. INTRODUCTION.....</b>	<b>1</b>
1.1 Applicant.....	1
1.2 Project.....	1
1.3 Proposed Activity .....	1
1.4 Terms of reference .....	5
1.5 Conditions of this report.....	5
1.6 Relevant legislation .....	5
<b>2. METHODOLOGY .....</b>	<b>6</b>
2.1 Assessment Approach and Philosophy .....	6
2.2 GIS (Mapping/Spatial Analysis) .....	8
3.1 Habitat and Floristic Analysis (Literature Study) .....	10
3.2 Ecology (Terrestrial Flora): Methods to be followed during Field Sampling and Assessment .....	11
3.3 Assessing species of conservation concern (SCC): .....	13
3.4 Ecological Mapping .....	14
3.5 Sensitivity Analysis and Criteria .....	14
3.6 Impact Assessment Methodology .....	17
3.7 Assumptions and Limitations .....	18

<b>3.</b>	<b>THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION .....</b>	<b>19</b>
<b>4.</b>	<b>DESCRIPTION OF THE AFFECTED ENVIRONMENT - BASELINE .....</b>	<b>19</b>
5.1	Broad-Scale Vegetation Patterns .....	19
5.2	Species of Conservation Concern (SCC) .....	24
5.2.1	Species of Conservation Concern (Flora) POC Assessment.....	25
5.3	Conservation Planning / Context .....	29
5.3.1	National Protected Areas Expansion Strategy .....	29
5.3.2	National Protected Areas Expansion Strategy .....	30
5.3.3	National Level of Conservation Priorities (Threatened Ecosystems).....	31
5.3.4	Critical Biodiversity Areas and Broad Scale Ecological Processes .....	33
<b>5.</b>	<b>FINDINGS OF THE BOTANICAL ASSESSMENT .....</b>	<b>37</b>
6.1	Site Specific Vegetation Description – Fine Scale Vegetation Patterns .....	37
<b>6.</b>	<b>ASSESSMENT OF PROPOSED IMPACTS .....</b>	<b>45</b>
7.1	Assumptions.....	45
7.2	Localised vs. cumulative impacts: some explanatory notes.....	45
7.3	Identification of Potential Botanical Impacts and Associated Activities .....	46
7.3.1	Site-establishment and Operational Phase .....	46
7.3.2	Cumulative Impacts .....	47
7.4	Assessment of Impacts .....	47
7.4.1	Assessment of impacts associated with Site-establishment and Operational Phases 47	
7.4.2	Assessment of Cumulative Impacts .....	49
7.5	Impact Mitigation and Management.....	53
<b>7.</b>	<b>CONCLUSION.....</b>	<b>57</b>
<b>8.</b>	<b>REFERENCES .....</b>	<b>58</b>

<b>9. APPENDICES .....</b>	<b>61</b>
Appendix 1: Plant Species List of the mining footprint and immediate surroundings.....	61
Appendix 2: Plant Species List of the region (POSA Generated List) .....	64
Appendix 3. Specialist CV.....	81
Appendix 4. Specialist’s Work Experience and References.....	84
Appendix 5. SACNASP CERTIFICATE .....	91

## LIST OF FIGURES

Figure 1: Location map of the proposed Waai Kraal Mine (Map compiled and provided by GreenMined Environmental (Pty) Ltd.).....	3
Figure 2: Location map of the proposed Waai Kraal Mine within Portion 4 of the Farm Waai Kraal 120 (Map compiled and provided by GreenMined Environmental (Pty) Ltd.). .....	4
Figure 3: Extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.....	11
Figure 4: Map illustrating the different vegetation units found within the region.....	28
Figure 5: National Level Terrestrial Conservation Planning Context. ....	35
Figure 6: National Level Aquatic Conservation Planning Context.....	36
Figure 7: Map illustrating the habitat units identified within the study area. ....	43
Figure 8: Map illustrating the botanical sensitivity of the project site.....	44

## LIST OF TABLES

Table 1: Data coverages used to inform the ecological and freshwater resource assessment.....	9
Table 2: Summary of the different aspects of biodiversity considered in the assessment of the study site. ....	12
Table 3: South African Red List Categories for species of conservation significance (adapted from SANBI, on-line at <a href="http://redlist.sanbi.org/redcat.php">http://redlist.sanbi.org/redcat.php</a> ). ....	13
Table 4: Explanation of sensitivity rating .....	15
Table 5: Key species associated with the Gamka Karoo according to Mucina and Rutherford (2006). ....	20
Table 6: Key species associated with the Upper Karoo Hardeveld according to Mucina and Rutherford (2006). ....	22

Table 7: Matrix used for the estimation and rating of flora/fauna species potential occurrence based on known habitat requirements/preferences and ranges.....	25
Table 8: Flora of conservation significance potentially occurring in the project area according to SANBI’s BODATSA-POSA online database. ....	26
Table 9: Summary of the conservation context details for the study area. ....	29
Table 10: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement. ....	31
Table 11: Conservation status of the vegetation types occurring in and around the proposed mining area. ....	33
Table 12: Relationship between Critical Biodiversity Areas categories (CBAs) and land management objectives.....	33
Table 13: Summary of results for the Dolerite Ridge Habitat.....	39
Table 14: Summary of results for the Karroid Grassy Plains.....	41

# **PROPOSED WAAI KRAAL AGGREGATE AND GRAVEL MINE, NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE**

## **BOTANICAL STUDY AND ASSESSMENT**

### **1. INTRODUCTION**

#### **1.1 Applicant**

Greenmined Environmental (Pty) Ltd. on behalf of Lombardskraal Doleriet (Pty) Ltd.

#### **1.2 Project**

The project will be known as Waai Kraal Mine.

#### **1.3 Proposed Activity**

Lombardskraal Doleriet (Pty) Ltd applied for a mining permit for the mining of gravel (4.9 ha), on a portion of Portion 4 of the farm Waai Kraal No 120 situated in the Beaufort West magisterial district of the Western Cape Province (Figure 1).

The proposed mining footprint will be 4.9 ha and will be developed over an undisturbed area of the farm occasionally used for grazing (Figure 2). The mining method will make use of blasting in order to loosen the hard rock; the material will then be loaded and hauled to the crushing plant where it will be screened to various sized stockpiles. The aggregate will be stockpiled until it is transported from site using tipper trucks. All mining related activities will be contained within the approved mining permit boundaries.

The proposed mining area is approximately 4.9 ha in extent and the applicant, intends to win material from the area for at least 2 years with a possible extension of another 3 years. The aggregate / gravel to be removed from the quarry will be used for construction industry in the vicinity.

The mining activities will consist out of the following:

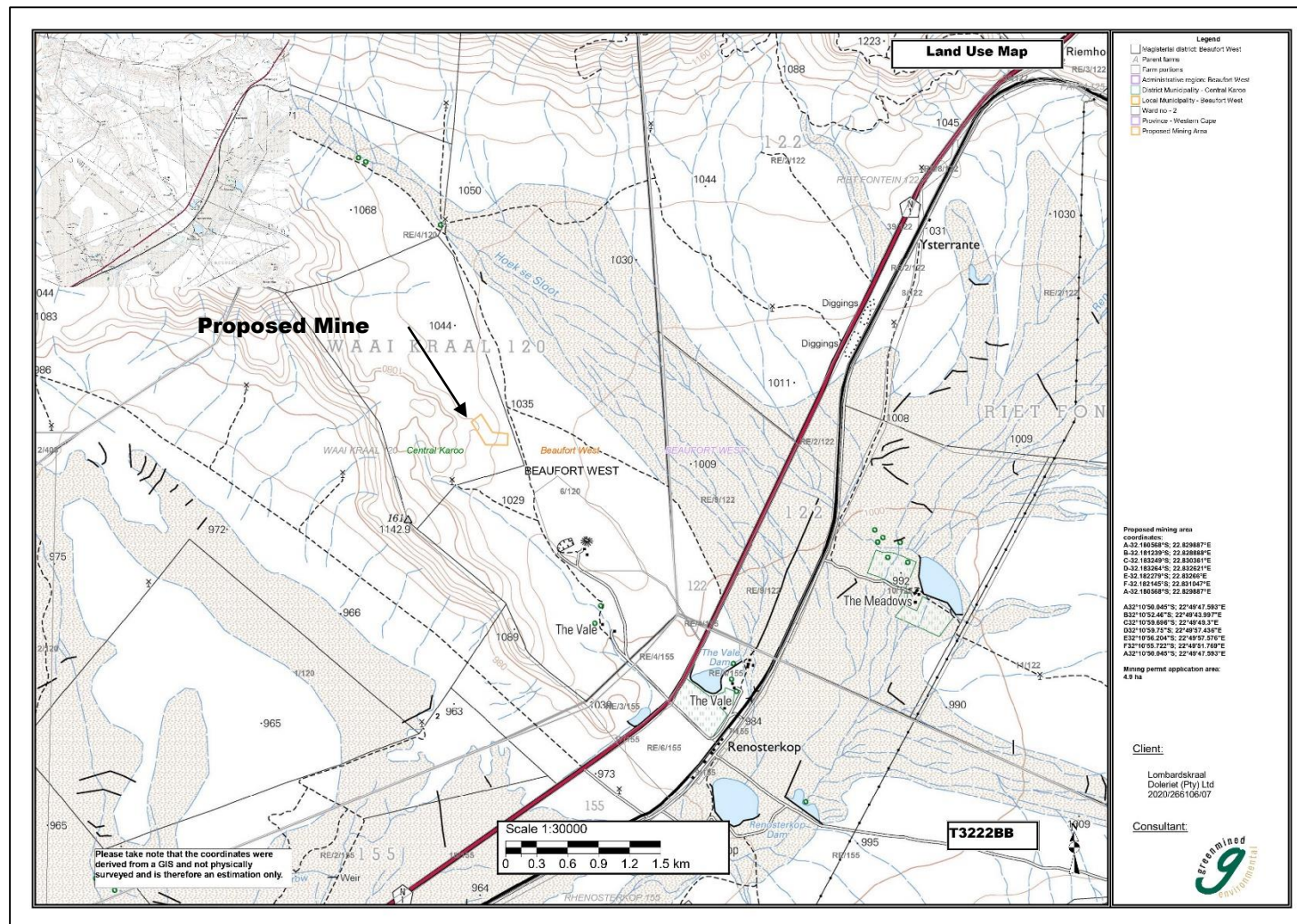
- Stripping and stockpiling of topsoil;
- » Blasting;



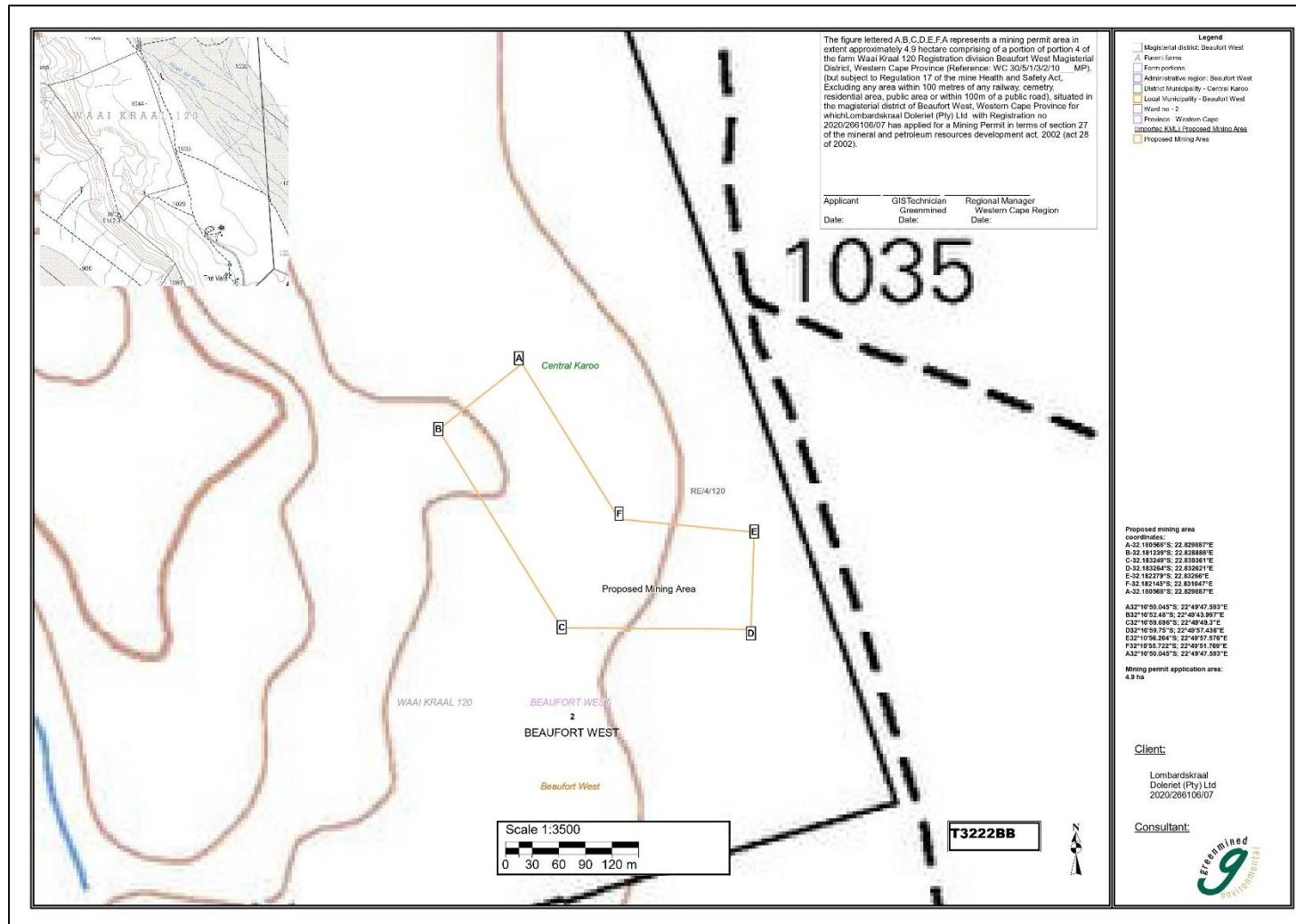
- » Excavating;
- » Crushing;
- » Stockpiling and transporting;
- » Sloping and landscaping upon closure of the site; and
- » Replacing the topsoil and vegetation the disturbed area.

The mining site will contain the following:

- » Excavating equipment;
- » Earth moving equipment;
- » Mobile crushing and screening plants;
- » Access Roads;
- » Site office (Container);
- » Site vehicles;
- » Parking area for visitors and site vehicles;
- » Weighbridge;
- » Ablution facilities (Chemical toilet).
  
- » Access Route:
  - Access to the proposed mining area will be via the N1, making use of the existing internal/haul roads to access the mining area.
  - Haul roads will be extended as the open cast mining progress, and will be rehabilitated as part of the final reinstatement of the area.
  
- » Water Use:
  - Any water required for the implementation of the project will be bought and transported to site.
  
- » Electricity:
  - The proposed project will not require any additional electricity connections, as power will be supplied, when needed, by generators.



**Figure 1:** Location map of the proposed Waaikraal Mine (Map compiled and provided by Greenmined Environmental (Pty) Ltd.).



**Figure 2:** Location map of the proposed Waai Kraal Mine within Portion 4 of the Farm Waai Kraal 120 (Map compiled and provided by GreenMined Environmental (Pty) Ltd.).

## 1.4 Terms of reference

To conduct a botanical study for a basic assessment of the target area where the establishment of the mine is proposed to be located and provide a professional opinion on botanical issues pertaining to the target area to aid in future decisions regarding the proposed project.

## 1.5 Conditions of this report

Findings, recommendations, and conclusions provided in this report are based on the authors best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.

## 1.6 Relevant legislation

The following legislation was taken into account whilst compiling this report:

### **Provincial**

- » The Western Cape Nature Conservation Act / WCNCA (Act No 19 of 1974);
- » Western Cape Nature Conservation Laws Amendment Act (WCNCLAA, Act No.3 of 2000);

The above-mentioned Nature Conservation Ordinance accompanied by all amendments is regarded by the Department of Environmental Affairs and Development Planning (DEADP-WC) as the legally binding, provincial documents, providing regulations, guidelines and procedures with the aim of protecting game and fish, the conservation of flora and fauna and the destruction of problematic (vermin and invasive) species.

### **National**

- » National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
- » Environment Conservation Act (ECA) (No 73 of 1989) and amendments
- » National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments
- » National Forest Act 1998 / NFA (No 84 of 1998)
- » National Veld and Forest Fire Act (Act No. 101 of 1998)
- » Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments

**International**

- » Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
- » The Convention on Biological Diversity
- » The Convention on the Conservation of Migratory Species of Wild Animals

**2. METHODOLOGY****2.1 Assessment Approach and Philosophy**

The assessment will be conducted according to the “newly” Gazetted Protocols 3(a) and (d) in terms of Section 24(5)(a) and 24(5)(h) of NEMA (Published on the 20<sup>th</sup> of March 2020), as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005) and for terrestrial flora as outlined by SANBI et al. (2020) .

This includes adherence to the following broad principles:

- » Where the sensitivity indicated in the Screening Tool is “Very High”, “High” or “Medium” for a proposed development footprint, then as indicated in the Protocol, an assessment must be conducted by a relevant taxon-specific specialist, the Initial Site Sensitivity Verification (ISSV) step indicates that the proposed development footprint consists of a “low” sensitivity, in which case the EAP/ specialist must submit a Terrestrial Animal / Plant Species Compliance Statement.
- » According to these “new” protocols, for the assessment and reporting of impacts on Terrestrial Biodiversity, the methodology and modelling used to undertake the assessment should be based on accepted, published methodology and modelling in order for findings to be consistent and repeatable.
- » Furthermore a precautionary and risk-averse approach must be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.
- » Demonstrate how the proponent intends complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should, in order of priority aim to:
  - Avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
  - Avoid degradation of the environment;
  - Avoid jeopardising ecosystem integrity;

- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;
- Control and minimise environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

The study will include data searches, desktop studies, site walkovers/field survey of the property and baseline data collection, describing:

- » A description of the broad botanical characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of pattern, the following will be identified or described:

#### ***Community and ecosystem level***

- » The main vegetation type, its aerial extent, and interaction with neighbouring types, soils or topography;
- » Threatened, vulnerable ecosystems or any significant landscape feature (cf. new SA vegetation map/National Spatial Biodiversity Assessment<sup>1</sup>, fine-scale systematic conservation plans, etc).
- » Ecological functioning and ecological processes (e.g. fire, migration, pollination etc.) that operate within the preferred site;

#### ***Species-level***

- » Species of Conservation Concern (SCC): Species that are threatened with extinction (i.e. IUCN listed as CR, EN or VU), or nationally assessed as rare and or/ range-restricted (giving location if possible, using GPS).
- » The distribution, location, viability, importance of conservation and detailed description of population size of the SCC that are present (include the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)

- » The likelihood of other SCC, other threatened species, undescribed species or highly localised endemics and/or migratory species occurring in the vicinity (include degree of confidence).
- » Buffer distances as per the Species Environmental Assessment Best Practice Guidelines.

***Other pattern issues***

- » Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- » The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than an infestation of undisturbed sites).
- » The condition of the site in terms of current or previous land uses.

In terms of process, the following will be identified or described:

- » The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire.
- » Ecological functioning and ecological processes (e.g. fire, migration, pollination etc.) that operate within the preferred site;
- » Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and vegetation boundaries such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- » Any possible changes in key processes e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- » Ecological connectivity and habitat fragmentation
- » Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- » All relevant legislation, permits, and standards that would apply to the development will be identified.
- » The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

**2.2 GIS (Mapping/Spatial Analysis)**

Data sources from the literature and GIS spatial information have been consulted and used where necessary in the study.

A National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) have been obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic desktop terrain analysis

has been performed on this DEM using ArcGis (10.4.1) software that encompassed a slope, landforms and channel network analyses in order to detect potential outcrops, ridges, landscape depressions and drainage networks.

The above-mentioned spatial data along with Google Earth Imagery (Google Earth ©) have been utilized to identify and delineate habitat/ecosystem features/units.

Additional existing data layers that will be incorporated into the scoping phase assessment, in order to determine important (sensitive) terrestrial and freshwater entities are summarised below in Table 1:

**Table 1:** Data coverages used to inform the ecological and freshwater resource assessment.

	Data/Coverage Type	Relevance	Source
Biophysical Context	<b>1:50 000 Relief Line</b> (5m Elevation Contours GIS Coverage)	Desktop mapping of terrain and habitat features as well as drainage network.	National Geo-Spatial Information (NGI)
	<b>1:50 000 River Line</b> (GIS Coverage)	Highlight potential on-site and local rivers and wetlands and map local drainage network.	CSIR (2011)
	<b>Western Cape Land-Cover</b> (from multi-seasonal Landsat 8)	Shows the land-use and disturbances/transformations within and around the impacted zone.	Cape Nature (2013/2014)
	<b>South African Vegetation Map</b> (GIS Coverage)	Classify vegetation types and determination of reference primary vegetation.	Mucina <i>et al.</i> (2018)
	<b>NFEPA: river and wetland inventories</b> (GIS Coverage)	Highlight potential on-site and local rivers and wetlands.	CSIR (2011)
	<b>NBA 2018 National Wetland Map 5</b> (GIS Coverage)	Highlight potential on-site and local wetlands	SANBI (2018)
	<b>NBA 2018 Artificial Wetlands</b> (GIS Coverage)	Highlight potential on-site and local artificial wetlands	SANBI (2018)
Conservation and Distribution Context	<b>NFEPA: River, wetland and estuarine FEPAs</b> (GIS Coverage)	Shows location of national aquatic ecosystems conservation priorities.	CSIR (2011)
	<b>National Biodiversity Assessment - Threatened Ecosystems</b> (GIS Coverage)	Determination of national threat status of local vegetation types.	SANBI (2011)
	<b>Terrestrial Critical Biodiversity Areas of Beaufort West Region</b> (GIS Coverage)	Determination of provincial terrestrial conservation priorities and biodiversity buffers.	CapeNature (2017)



<b>SAPAD – South Africa Protected Areas Database (GIS Coverage)</b>	Shows the location of protected areas within the region	<a href="http://egis.environment.gov.za">http://egis.environment.gov.za</a> DEA (2020)
<b>SACAD – South Africa Conservation Areas Database (GIS Coverage)</b>	Shows the location of conservation areas within the region	<a href="http://egis.environment.gov.za">http://egis.environment.gov.za</a> DEA (2020)
<b>Strategic Water Source Areas for Surface Water (SWSA-sw) (GIS Coverage)</b>	Shows the location of the development area relative to areas that contribute significantly to the overall water supply of the country	CSIR (2017)

### 3.1 Habitat and Floristic Analysis (Literature Study)

The Botanical Database of Southern Africa (BODATSA) as well as iNaturalist have been consulted in order to obtain a list of species recorded within the area. This species list will provide an indication of the potential diversity expected within the area, the potential presence of range restricted species and other Species of Conservation Concern (SCC). The Red List of South African Plants website (SANBI, 2016) will also be utilized to provide the most current account of the national status of flora. Based on this analysis of available floristic literature, as well as the identification and delineation of habitat units, a list of SCC likely to occur within the project site have be generated.

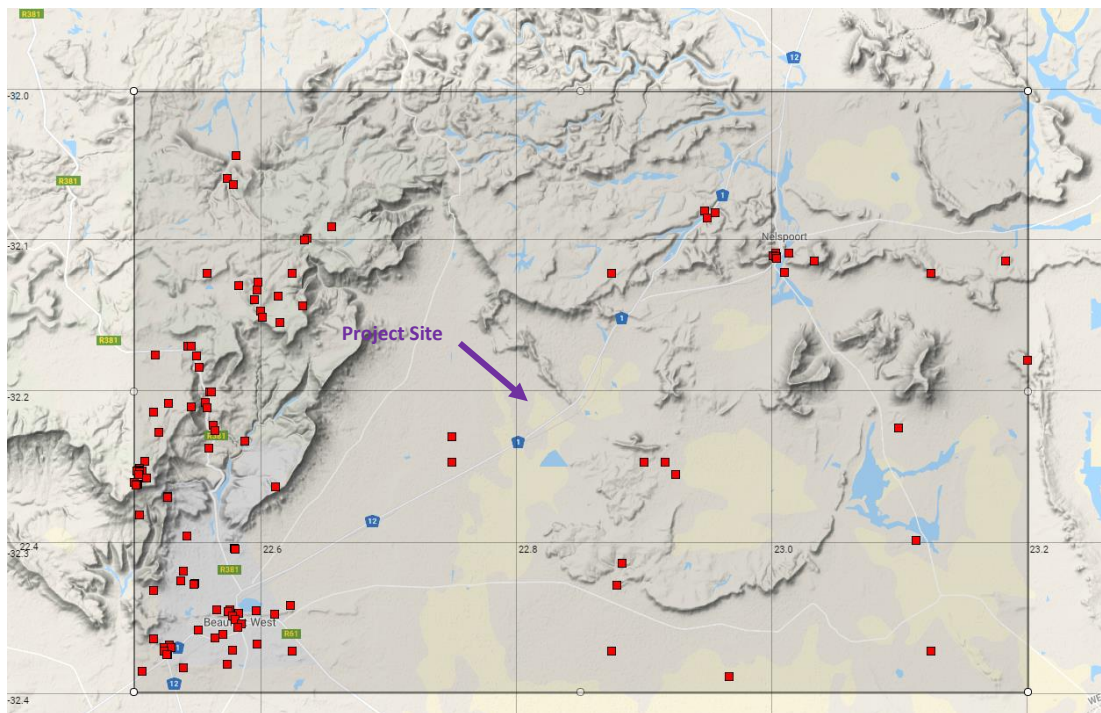
Additional information regarding ecosystems, vegetation types, and SCC will include the following sources:

- » The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19., 2018);
- » Grassland Ecosystem Guidelines: landscape interpretation for planners and managers (SANBI, 2013); and
- » Red List of South African Plants (Raimondo, et al., 2009; SANBI, 2016).

Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- » South African Wild Flower Guide 6: Karoo (Botanical Society of South Africa, 2008)
- » Plants of the Klein Karoo (Vlok & Schutte-Vlok, 2010)
- » Guide to grasses of Southern Africa (Van Oudtshoorn, 1999);
- » Identification guide to southern African grasses. An identification manual with keys, descriptions and distributions. (Fish, Mashau, Moeaha, & Nembudani, 2015).
- » Bossieveld: Weiplante van die Karoo en karoogative gebiede (Le Roux, 1994)

» Plant Identification for the Nama-Karoo App. Ver 1.0.2 (GADI, 2020)



**Figure 3:** Extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.

### 3.2 Ecology (Terrestrial Flora): Methods to be followed during Field Sampling and Assessment

As part of the BA process, a detailed field survey of the vegetation of the development footprint was undertaken (on the 14<sup>th</sup> of November 2020). The month of November falls within the wet season (early or start of wet season) and is regarded as an acceptable period to conduct such an assessment as this period of time is regarded as the active growing season for most flora of the region. Furthermore, the area has received some early spring/summer rain and have stimulated flowering of various floral species.

The main purpose of the field survey was to:

- » Inspecting the various habitat, vegetation and landscape units that are present the mining site and to correlate such observations with the results of the desktop study.
- » Identifying all observed species that were recorded within the development footprint.
- » Providing a list of protected species and SCC.
- » Noting the presence of sensitive habitats such quartz patches, drainage lines and unique edaphic environments,

The data collected were then used to map these features onto satellite imagery of the site and to manually adjust the preliminary habitat units where necessary.

Aspects of biodiversity that were used to guide the interpretation and assessment of the study area are summarized below (Table 2).

**Table 2:** Summary of the different aspects of biodiversity considered in the assessment of the study site.

<b>Intrinsic / Ecological Values</b>
<b>Species-level aspects of biodiversity</b>
<ul style="list-style-type: none"> <li>» Protected species of flora;</li> <li>» Threatened Species (Red Data List);</li> <li>» Keystone species performing a key ecological role;</li> <li>» Large or congregatory species population;</li> <li>» Endemic species or species with restricted ranges;</li> <li>» Previously unknown species.</li> </ul>
<b>Community &amp; ecosystem-level aspects of biodiversity</b>
<ul style="list-style-type: none"> <li>» Distinct or diverse communities or ecosystems;</li> <li>» Unique ecosystems;</li> <li>» Locally adapted communities or assemblages;</li> <li>» Species-rich or diverse ecosystems;</li> <li>» Communities with a high proportion of endemic species or species with restricted ranges;</li> <li>» Communities with a high proportion of threatened and/or declining species;</li> <li>» The main uses and users of the area and its ecosystem goods and services: important ecosystem services, valued ecosystem goods, valued cultural areas.</li> </ul>
<b>Community &amp; ecosystem-level aspects of biodiversity</b>
<ul style="list-style-type: none"> <li>» Key ecological processes (e.g. seed dispersal, pollination, primary production, carbon sequestration);</li> <li>» Areas with large congregations or species and/or breeding grounds;</li> <li>» Migration routes/corridors;</li> <li>» Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas;</li> <li>» Importance and role in the landscape with regard to arrangement of 'spatial components of ecological processes', comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland gradients and macro-climatic gradients), as well as important movement or migration corridor for species.</li> </ul>

The following data sampling techniques were utilized during the field survey:

- » The Zurich–Montpellier (Braun-Blanquet Plot) approach, was initially utilized and are the recommended approach in identifying the different plant communities/ecosystems/habitats. Ecological data sampled during this approach is then used to identify and describe important ecological drivers/processes and ecosystem functions.
- » Following plot sampling (Zurich-Montpellier) a relative short-timed meander/transect was walked in order to identify any potential plant species that has not been identified during plot sampling including any potential Floral SCC.

### 3.3 Assessing species of conservation concern (SCC):

Species of conservation concern are species that have high conservation importance in terms of preserving South Africa's biodiversity. A description of the different SANBI categories of species of conservation concern is provided in Table 3, below.

**Table 3:** South African Red List Categories for species of conservation significance (adapted from SANBI, on-line at <http://redlist.sanbi.org/redcat.php>).

Present State			
Species of Conservation Concern		Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
	Threatened Species	Critically Endangered, Possibly Extinct (CR PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is, therefore, likely to become at risk of extinction in the near future.
		Critically Rare	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
		Data Deficient – Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.

<b>Other</b>	Data Deficient – Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined so that an assessment of risk of extinction is not possible.
	Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
	Not Evaluated (NE)	species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

As mentioned, flora of conservation significance (including threatened, protected and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of SANBI’s PRECIS (National Herbarium Pretoria Computerized Information System) electronic database. This information was used to identify potential habitat in the project area that could support these species based on information on each species’ particular habitat preferences which were obtained from SANBI online species database. Special attention was given to the identification of any of these Red Data species as well as the identification of suitable habitat for Red Data species observed during field investigations.

### 3.4 Ecological Mapping

As mentioned, mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery (which is a generalised colour composite image without any actual reflectance data attached to it) and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual mergers of vegetation units, generalisations had to be made. Mapped units will thus show where a certain vegetation unit is predominant, but smaller inclusions of another vegetation type in this area do exist but have not been mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery (with all reflectance data), which has not been available to this project due to the high cost of such imagery.

### 3.5 Sensitivity Analysis and Criteria

A broad-scale ecological sensitivity map of the site was produced by integrating the available ecological and biodiversity information available in the literature and various spatial databases

(e.g. SIBIS, BGIS). The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

**Table 4:** Explanation of sensitivity rating

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
<b>VERY HIGH</b>	<p>Indigenous natural areas that are highly positive for any of the following:</p> <ul style="list-style-type: none"> <li>▪ Critical habitat for range restricted species of conservation concern that have a distribution range of less than 10 km<sup>2</sup></li> <li>▪ Presence of species of conservation concern listed on the IUCN Red List of Threatened Species or South Africa’s National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria or listed as Nationally Rare</li> <li>▪ Habitats/Vegetation types with high conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk).</li> <li>▪ Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas, Lake Areas Development Act).</li> </ul> <p style="color: #d62728;">These areas/habitats are irreplaceable in terms of species of conservation concern</p> <p>May also be positive for the following:</p> <ul style="list-style-type: none"> <li>▪ High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems)</li> <li>▪ High value ecological goods and services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value)</li> <li>▪ Low ability to respond to disturbance (low resilience, dominant species very old).</li> </ul>	<ul style="list-style-type: none"> <li>▪ CBA 1 areas</li> <li>▪ Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered, or Vulnerable.</li> <li>▪ Protected forest patches.</li> <li>▪ Confirmed presence of populations of species of conservation concern (Critically Endangered, Endangered, Vulnerable &amp; Rare)</li> </ul>
<b>HIGH</b>	<p>Indigenous natural areas that are positive for any of the following:</p> <ul style="list-style-type: none"> <li>▪ High intrinsic biodiversity value (moderate/high species richness and/or turnover).</li> <li>▪ Confirmed habitat highly suitable for species of conservation concern (Those species listed on the IUCN Red List of Threatened Species or South Africa’s National Red List website as Critically Endangered, Endangered or Vulnerable</li> </ul>	<ul style="list-style-type: none"> <li>▪ CBA 2 “critical biodiversity areas”.</li> <li>▪ Confirmed habitat where species of conservation concern could potentially occur (habitat is suitable, but no confirmed records).</li> </ul>

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	<p>according to the IUCN Red List 3.1. Categories and Criteria).</p> <ul style="list-style-type: none"> <li>▪ Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age).</li> <li>▪ Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk).</li> <li>▪ Moderate to high value ecological goods &amp; services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value).</li> </ul> <p style="color: red;">These areas/habitats are unsuitable for development due to a very likely impact on species of conservation concern</p> <p>May also be positive for the following:</p> <ul style="list-style-type: none"> <li>▪ Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Habitat containing individuals of extreme age.</li> <li>▪ Habitat with low ability to recover from disturbance.</li> <li>▪ Habitat with exceptionally high diversity (richness or turnover).</li> <li>▪ Habitat with unique species composition and narrow distribution.</li> <li>▪ Ecosystem providing high value ecosystem goods and services.</li> </ul>
<b>Medium</b>	<p>Indigenous natural areas that are positive for:</p> <ul style="list-style-type: none"> <li>▪ Suspected habitat for species of conservation concern based either on there being records for this species collected in the past prior to 2002 or being a natural area included in a habitat suitability model (Those species listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria).</li> </ul> <p>Indigenous natural areas that are positive for one or two of the factors listed below,</p> <ul style="list-style-type: none"> <li>▪ Moderate intrinsic biodiversity value (moderate species richness and/or turnover).</li> <li>▪ Moderate to moderate low ability to respond to disturbance (moderate resilience, dominant species of intermediate age).</li> <li>▪ Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk).</li> <li>▪ Moderate value ecological goods &amp; services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value).</li> </ul>	<ul style="list-style-type: none"> <li>▪ CBA 2 "corridor areas", ESA 1 and ESA2.</li> <li>▪ Habitat with moderate diversity (richness or turnover).</li> <li>▪ Suspected habitat for species of conservation concern.</li> </ul>
<b>Low</b>	Degraded or disturbed indigenous natural vegetation	

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	No Natural habitat remaining	

### 3.6 Impact Assessment Methodology

The assessment methodology is in accordance with the recent revised 2014 EIA regulations. The significance of environmental impacts is a function of the environmental aspects that are present and to be impacted on, the probability of an impact occurring and the consequence of such an impact occurring before and after implementation of proposed mitigation measures.

The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

- » The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
- » The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 is assigned as appropriate (with 1 being low and 5 being high).
- » The **duration**, wherein it was indicated whether:
  - the lifetime of the impact will be of a very short duration (0 – 1 year) – assigned a score of 1;
  - the lifetime of the impact will be of short duration (2 – 5 years) – assigned a score of 2;
  - medium-term (5 -15 years) – assigned a score of 3;
  - long term (> 15 years) – assigned a score of 4; or
  - permanent – assigned a score of 5.
- » The **magnitude**, quantified on a scale from 0 – 10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale of 1 -5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- » The **significance** is determined through a synthesis of the characteristics described above and can be assessed as **LOW**, **MEDIUM** or **HIGH**; and



- » the **status**, which was described as either positive, negative or neutral;
- » the degree of which the impact can be reversed;
- » the degree to which the impact may cause irreplaceable loss of resources; and
- » the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

$S=(E+D+M)P$  where;

- » S = Significance weighting
- » E = Extent
- » D = Duration
- » M = Magnitude
- » P = Probability

The significance weightings for each potential impact are as follows;

- » < 30 points: **LOW** (i.e. where the impact would not have a direct influence on the decision to develop in the area),
- » 30 – 60 points: **MEDIUM** (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- » > 60 points: **HIGH** (i.e. where the impact must have an influence on the decision process to develop in the area).

### 3.7 Assumptions and Limitations

This report deals exclusively with a defined area and the impacts upon flora biodiversity and natural ecosystems in that area.

- » All relevant project information provided by the applicant and engineering design team to the ecological specialist was correct and valid at the time that it was provided.
- » Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.
  - Temporal variation plays an important role in the structure and patterns of plant biodiversity, plant communities, and plant species occurrences. As such, a single site visit may therefore not fully catalogue all plant species diversity in an area, for example due to seasonal variation of vegetation, since the temporal window of sampling is narrow. Thus, the ideal situation would be to visit a site several times during different seasons, which would ensure that most, if not all, plant species present are observed and recorded. However, time and cost constraints make multiple site visits nearly impossible, and the species observed and recorded at the time of the site visit should

therefore be critically evaluated as they might not fully represent the complete plant community.

### 3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term 'Biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only all living things but also the series of interactions that sustain them, which are termed 'ecological processes'. South Africa's biodiversity provides an important basis for economic growth and development; and keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services, such as the production of clean water through good catchment management. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver et al., 2012). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species, pollution and waste and climate change (Driver et al., 2012). High levels of infrastructural and agricultural development typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence both ecosystems and species, in the face of human development and global climatic change. Loss of biodiversity puts aspects of our economy and quality of life at risk and reduces socioeconomic options for future generations as well. In essence, then, sustainable development is not possible without it.

### 4. DESCRIPTION OF THE AFFECTED ENVIRONMENT - BASELINE

#### 5.1 Broad-Scale Vegetation Patterns

The majority of the proposed site is located within the Gamka Karoo Vegetation Type whilst a small portion of the north-western corner of the site falls within the Upper Karoo Hardeveld Vegetation Type (Mucina & Rutherford, 2018) (Figure 4). The Gamka Karoo unit covers approximately 20324.9 km<sup>2</sup> of land area whilst the Upper Karoo Hardeveld covers an area of approximately 11734.3 km<sup>2</sup>. Both of these Vegetation Units are classified as Least Threatened, with 99.7% of the Upper Karoo Hardeveld and 99.5% of the Gamka Karoo still intact; these vegetation types have thus not been significantly transformed.

#### ***Gamka Karoo Vegetation Type***

The Gamka Karoo Vegetation Type is predominantly found within a large basin between the Great Escarpment (Nuweveld Mountains) in the north and northwest and the Cape Fold Belt Mountains (mostly Swartberg Mountains) in the south and from approximately the edge of the

Gamka basin catchment area (i.e. Dwyka River tributary) in the west to about the Kariega River in the east. This vegetation type occupies a highly irregular to slightly undulation plains landscape covered with dwarf spiny shrubland dominated by Karoo dwarf shrubs (e.g. *Chrysocoma ciliata*, *Eriocephalus ericoides*) with rare low trees (e.g. *Euclea undulata*). Dense stands of drought-resistant grasses (*Stipagrostis*, *Aristida*) cover (especially after abundant rains) broad sandy bottomlands (Mucina & Rutherford, 2006).

This vegetation type comprises a geology of mainly Mudstones and sandstones of the Beaufort Group (Adelaide Subgroup) with some Ecca (Fort Brown) shales supporting very shallow and stony soils of the Glenrosa and/or Mispah forms, typical of Fc landtype.

**Table 5:** Key species associated with the Gamka Karoo according to Mucina and Rutherford (2006).

DOMINANT SPECIES	
Growth Form	Key Species
<b>Tall Shrub</b>	<i>Lycium cinereum</i> , <i>Lycium oxycarpum</i> , <i>Rhigozum obovatum</i> , <i>Acacia (Vachellia) karroo</i> , <i>Cadaba aphylla</i> , <i>Lycium schizocalyx</i> , <i>Searsia burchellii</i> <i>Sisyndite spartea</i>
<b>Low Shrubs</b>	<i>Chrysocoma ciliata</i> , <i>Eriocephalus ericoides</i> subsp. <i>ericoides</i> , <i>Eriocephalus spinescens</i> , <i>Felicia muricata</i> , <i>Galenia fruticosa</i> , <i>Limeum aethiopicum</i> , <i>Pentzia incana</i> , <i>Pteronia adenocarpa</i> , <i>Rosenia humilis</i> , <i>Aptosimum indivisum</i> , <i>Asparagus burchellii</i> , <i>Blepharis mitrata</i> , <i>Eriocephalus microphyllus</i> var. <i>pubescens</i> , <i>Felicia filifolia</i> subsp. <i>filifolia</i> , <i>Felicia muricata</i> subsp. <i>cinerascens</i> , <i>Galenia secunda</i> , <i>Garuleum bipinnatum</i> , <i>Garuleum latifolium</i> , <i>Gomphocarpus filiformis</i> , <i>Helichrysum lucilioides</i> , <i>Hermannia desertorum</i> , <i>Hermannia grandiflora</i> , <i>Hermannia spinosa</i> , <i>Melolobium candicans</i> , <i>Microloma armatum</i> , <i>Monechma spartioides</i> , <i>Pentzia pinnatisecta</i> , <i>Plinthus karooicus</i> , <i>Polygala seminuda</i> , <i>Pteronia glauca</i> , <i>Pteronia sordida</i> , <i>Pteronia viscosa</i> , <i>Selago geniculata</i> , <i>Sericocoma avolans</i> , <i>Zygophyllum microcarpum</i> , <i>Zygophyllum microphyllum</i>
<b>Succulent Shrubs</b>	<i>Ruschia intricata</i> , <i>Aridaria noctiflora</i> subsp. <i>straminea</i> , <i>Crassula muscosa</i> , <i>Drosanthemum lique</i> , <i>Galenia sarcophylla</i> , <i>Kleinia longiflora</i> , <i>Ruschia spinosa</i> , <i>Salsola tuberculata</i> , <i>Sarcocaulon patersonii</i> , <i>Trichodiadema barbatum</i> , <i>Tripteris sinuata</i> var. <i>linearis</i>
<b>Semi-parasitic Shrub</b>	<i>Thesium lineatum</i>
<b>Herbs</b>	<i>Gazania lichtensteinii</i> , <i>Chamaesyce inaequilatera</i> , <i>Dicoma capensis</i> , <i>Galenia glandulifera</i> , <i>Lepidium africanum</i> subsp. <i>africanum</i> , <i>Lepidium desertorum</i> , <i>Lessertia pauciflora</i> var. <i>pauciflora</i> , <i>Leysera tenella</i> , <i>Osteospermum microphyllum</i> , <i>Sesamum capense</i> , <i>Tetragonia microptera</i> , <i>Tribulus terrestris</i> , <i>Ursinia nana</i> ,
<b>Geophytic Herbs</b>	<i>Drimia intricata</i> , <i>Moraea polystachya</i>
<b>Graminoids</b>	<i>Aristida congesta</i> , <i>Aristida diffusa</i> , <i>Fingerhuthia africana</i> , <i>Stipagrostis ciliata</i> , <i>Stipagrostis obtusa</i> , <i>Aristida adscensionis</i> , <i>Cenchrus ciliaris</i> ,

	<i>Digitaria argyrograpta, Enneapogon desvauxii, Enneapogon scaber, Eragrostis homomalla, Eragrostis lehmanniana, Eragrostis obtusa, Tragus berteronianus, Tragus koelerioides</i>
Bioregional Important Taxa	
Growth Form	Key Species
<b>Succulent Shrubs</b>	<i>Hereroa latipetala, Hereroa odorata, Pleiospilos compactus, Rhinephyllum luteum, Stapelia engleriana</i>
<b>Geophytic Herb</b>	<i>Tritonia tugwelliae</i>
<b>Low Shrubs</b>	<i>Felicia lasiocarpa</i>
<b>Succulent Herbs</b>	<i>Piaranthus comptus, Tridentea parvipuncta subsp. parvipuncta,</i>
<b>Graminoid</b>	<i>Oropetium capense</i>
Endemic Taxa	
Growth Form	Key Species
<b>Succulent Shrubs</b>	<i>Chasmatophyllum stanleyi, Hereroa incurve, Hoodia dregei, Ruschia beaufortensis</i>
<b>Low Shrubs</b>	<i>Jamesbrittenia tenuifolia</i>
<b>Herb</b>	<i>Manulea karrooica</i>
<b>Succulent Herb</b>	<i>Piaranthus compactus</i>

### **Upper Karoo Hardeveld Vegetation Type**

The Upper Karoo Hardeveld Vegetation Type occupies discrete areas of slopes and ridges including dolerite dykes and sills in the region spanning Middelpos in the west and Strydenburg, Richmond and Nieu-Bethesda in the east. This vegetation type also occupies most of the crest areas and steep slopes of the Great Escarpment facing south between Teekloofpas and Eastwards to Graaf-Reinet. The landscape typifying this vegetation type is steep slopes of koppies, butts, mesas and, as mentioned, parts of the Great Escarpment covered with large boulders and stones supporting sparse dwarf Karoo scrub with drought-tolerant grasses of genera such as *Aristida, Eragrostis* and *Stipagrostis* (Mucina & Rutherford, 2006).

This vegetation type is associated with primitive, skeletal soils in rocky areas developing over sedimentary rocks such as mudstones and arenites of the Adelaide Subgroup of the Karoo Supergroup and to lesser extent also the Ecca Group (Waterford and Volksrust Formations) as well as Jurassic dolerite sills and dykes and subsummit portions of mesas and butts with dolerite boulder slopes. Almost entirely Ib land type.

According to Mucina & Rutherford (2006) this vegetation type is one of the richer floras of the Nama-Karoo Biome.

**Table 6:** Key species associated with the Upper Karoo Hardeveld according to Mucina and Rutherford (2006).

DOMINANT SPECIES	
Growth Form	Key Species
<b>Tall Shrub</b>	<i>Lycium cinereum</i> , <i>Rhigozum obovatum</i> , <i>Cadaba aphylla</i> , <i>Diospyros austro-africana</i> , <i>Ehretia rigida</i> subsp. <i>rigida</i> , <i>Lycium oxycarpum</i> , <i>Melianthus comosus</i> , <i>Rhus burchellii</i> ,
<b>Low Shrubs</b>	<i>Chrysocoma ciliata</i> , <i>Eriocephalus ericoides</i> subsp. <i>ericoides</i> , <i>Euryops lateriflorus</i> , <i>Felicia muricata</i> , <i>Limeum aethiopicum</i> , <i>Pteronia glauca</i> , <i>Amphiglossa triflora</i> , <i>Aptosimum elongatum</i> , <i>Aptosimum spinescens</i> , <i>Asparagus mucronatus</i> , <i>Asparagus retrofractus</i> , <i>Asparagus striatus</i> , <i>Asparagus suaveolens</i> , <i>Eriocephalus spinescens</i> , <i>Euryops annae</i> , <i>Euryops candollei</i> , <i>Euryops empetrifolius</i> , <i>Euryops nodosus</i> , <i>Felicia filifolia</i> subsp. <i>filifolia</i> , <i>Garuleum latifolium</i> , <i>Helichrysum lucilioides</i> , <i>Helichrysum zeyheri</i> , <i>Hermannia filifolia</i> var. <i>filifolia</i> , <i>Hermannia multiflora</i> , <i>Hermannia pulchella</i> , <i>Hermannia vestita</i> , <i>Indigofera sessilifolia</i> , <i>Jamesbrittenia atropurpurea</i> , <i>Lessertia frutescens</i> , <i>Melolobium candicans</i> , <i>Melolobium microphyllum</i> , <i>Microloma armatum</i> , <i>Monechma incanum</i> , <i>Nenax microphylla</i> , <i>Pegolettia retrofracta</i> , <i>Pelargonium abrotanifolium</i> , <i>Pelargonium ramosissimum</i> , <i>Pentzia globosa</i> , <i>Pentzia spinescens</i> , <i>Plinthus karooicus</i> , <i>Polygala seminuda</i> , <i>Pteronia adenocarpa</i> , <i>Pteronia sordida</i> , <i>Rosenia humilis</i> , <i>Selago albida</i> , <i>Solanum capense</i> , <i>Sutera halimifolia</i> , <i>Tetragonia arbuscula</i> , <i>Wahlenbergia tenella</i> ,
<b>Succulent Shrubs</b>	<i>Aloe broomii</i> , <i>Drosanthemum lique</i> , <i>Faucaria bosscheana</i> , <i>Kleinia longiflora</i> , <i>Pachypodium succulentum</i> , <i>Trichodiadema barbatum</i> , <i>Zygophyllum flexuosum</i> ,
<b>Semi-parasitic Shrub</b>	<i>Thesium lineatum</i>
<b>Herbs</b>	<i>Troglophyton capillaceum</i> subsp. <i>capillaceum</i> , <i>Dianthus caespitosus</i> subsp. <i>caespitosus</i> , <i>Gazania kerbsiana</i> , <i>Lepidium africanum</i> subsp. <i>africanum</i> , <i>Leysera tenella</i> , <i>Pelargonium minimum</i> , <i>Sutera pinnatifida</i> , <i>Tribulus terrestris</i> ,
<b>Geophytic Herbs</b>	<i>Albuca setosa</i> , <i>Androcymbium albomarginatum</i> , <i>Asplenium cordatum</i> , <i>Boophone disticha</i> , <i>Cheilanthes bergiana</i> , <i>Drimia intricata</i> , <i>Oxalis depressa</i>
<b>Graminoids</b>	<i>Aristida adscensionis</i> , <i>Aristida congesta</i> , <i>Aristida diffusa</i> , <i>Cenchrus ciliaris</i> , <i>Enneapogon desvauxii</i> , <i>Eragrostis lehmanniana</i> , <i>Eragrostis obtusa</i> , <i>Sporobolus fimbriatus</i> , <i>Stipagrostis obtusa</i> , <i>Cynodon incompletus</i> , <i>Digitaria eriantha</i> , <i>Ehrharta calycina</i> , <i>Enneapogon scaber</i> , <i>Enneapogon scoparius</i> , <i>Eragrostis curvula</i> , <i>Eragrostis nindensis</i> , <i>Eragrostis procumbens</i> , <i>Fingerhuthia africana</i> , <i>Heteropogon contortus</i> , <i>Merxmüllera disticha</i> , <i>Stipagrostis ciliata</i> , <i>Themeda triandra</i> , <i>Tragus berteronianus</i> , <i>Tragus koelerioides</i> ,
<b>Bioregional Important Taxa</b>	

Growth Form	Key Species
<b>Graminoid</b>	<i>Eragrostis lehmanniana</i>
Endemic Taxa	
Growth Form	Key Species
<b>Succulent Shrubs</b>	<i>Aloe chlorantha</i> , <i>Crassula barbata</i> subsp. <i>broomii</i> , <i>Delosperma robustum</i> , <i>Sceletium expansum</i> , <i>Stomatium suaveolens</i>
<b>Low Shrubs</b>	<i>Cineraria polycephala</i> , <i>Euryops Petraeus</i> , <i>Lotononis azureoides</i> , <i>Selago magnakarooica</i>
<b>Tall Shrubs</b>	<i>Anisodonteia malvastroides</i>
<b>Herbs</b>	<i>Cineraria arctotidea</i> , <i>Vellereophyton niveum</i>
<b>Succulent Herbs</b>	<i>Adromischus fallax</i> , <i>Adromischus humilis</i>
<b>Geophytic Herbs</b>	<i>Gethyllis longistyla</i> , <i>Lachenalia aurioliae</i> , <i>Ornithogalum paucifolium</i> subsp. <i>karooparkense</i>

A species list from the SANBI database (BODATSA-POSA, 2020) containing the species that have been recorded to date within the surroundings of the study area has been compiled. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants published by SANBI in Strelitzia 25 (Raimondo *et al.* 2009, updated 2013). Only protected and red data species that may potentially occur in the study area have been listed within the baseline study section of this report. The actual field survey confirmed which of the species already recorded actually occurs in the study area, and indicates the presence of additional species that may not have been recorded in official databases to date.

A total of 696 species have been recorded within the broader area (Figure 3), and indicates that the prominent growth forms within the area are Forbs (239 species), Succulent Dwarf Shrubs (101 species), Forbs (98 species), Graminoids (78 species) and Geophytic Forbs (58 species). Succulence is a relative common feature within the region with a total of 130 succulent species that have been recorded within the region.

Plant families prominent within the area, include Aizoaceae, Asteraceae, Poaceae, Scrophulariaceae, Fabaceae, Geraniaceae, Hyacinthaceae, Malvaceae and Crassulaceae. Species belonging to these nine families contribute almost 60% to the total species that have been recorded within the region. Especially the Asteraceae family was well represented with 120 species recorded within the region. The other two dominant plant families recorded within the region include, Poaceae and Scrophulariaceae.

Of the 696 species recorded, 662 are indigenous species of which 205 species are South African Endemics. Of these SA Endemics, only nine species are relatively range restricted, which includes the study area namely; *Anisodonteia malvastroides*, *Crassula barbata*, *Selago magnakarooica*, *Piarranthus comptus*, *Hereroa concava*, *Euphorbia hypogaea*, *Stomatium suaveolens*, *Gethyllis longistyla*, *Haworthia marumiana*. The Potential of Occurrence (POC) for these species within the study site will be assessed in the following sections.

A total of 33 non-indigenous vegetation has been recorded within the region and includes nine listed Alien Invasive Plants (AIPs) according to the updated 2019 list in accordance with the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Alien and Invasive Species List (2016). Seven of the nine recorded AIPs were listed as Category 1b plants, whilst one species (*Tephrocactus articulatus*) was listed as a Category 1a plant and one species (*Atriplex nummularia*) as a Category 2 plant. The Category 1b plants recorded within the region are; *Prosopis glandulosa*, *P. velutina*, *Opuntia ficus-indica*, *Opuntia spp.*, *Pennisetum setaceum*, *Salsola kali* and *Cylindropuntia imbricata*.

## 5.2 Species of Conservation Concern (SCC)

Species of conservation concern refer to species of flora (plants) that have a high level of conservation importance in terms of preserving South Africa's high biological diversity and include threatened species that have been classified as 'at high risk of extinction in the wild'. If a subpopulation of a species of conservation concern is found to occur on a proposed development site, it would be one indicator that development activities could result in significant loss of biodiversity, bearing in mind that loss of subpopulations of these species will either increase their extinction risk or may in fact contribute to their extinction.

BODATSA-POSA as well as iNaturalist databases as well as other publications were used to assess the Potential Occurrence (POC) of SCC flora for the study area and development site, with following parameters were then used to assess the probability of occurrence:

- » Species range: Species often have specific geographical/altitudinal ranges in which they occur or are restricted to and the location of the project area in relation to these distributional ranges was evaluated based on available information.
- » Habitat requirements: Most SCC have very specific habitat requirements/preferences and the presence/absence of these habitat characteristics in the study area was evaluated.
- » Habitat status: Often a high level of habitat degradation in a specific habitat will negate the presence of SCC which are typically sensitive to disturbance; hence the status or ecological condition/suitability of available habitat in the area was assessed.
- » Habitat connectivity: Movement between areas forms an essential part of the life-cycle and persistence of many species. Isolated/patchy habitats are generally not well-suited

for harbouring SCC; however, this is not always the case. Connectivity of the study area to surrounding habitat and the adequacy of these linkages were evaluated.

The habitat requirements/preferences for each plant SCC was thus reviewed (based on available literature) and was compared with the habitat occurring at the site (initially based on imagery which was then verified through site visits) in order to estimate the likelihood of these species occurring on the target property (as per the assessment matrix in Table 7, below).

**Table 7:** Matrix used for the estimation and rating of flora/fauna species potential occurrence based on known habitat requirements/preferences and ranges.

		SPECIES HABITAT REQUIREMENTS/PREFERENCES			
		Fully met	Largely met	Partially met	Not met
		Natural Condition	Fair Condition	Poor-Fair Condition	Poor Condition/ Transformed
SPECIES DISTRIBUTION/RANGE	Habitat occurs within known species geographical/altitudinal range	Highly Probable	Possible	Unlikely	Highly Unlikely or Improbable
	Habitat occurs on the edge of known species geographical/altitudinal range	Possible	Possible	Unlikely	Highly Unlikely or Improbable
	Habitat occurs outside of known species geographical/altitudinal range	Unlikely	Unlikely	Highly Unlikely or Improbable	Highly Unlikely or Improbable

### 5.2.1 Species of Conservation Concern (Flora) POC Assessment

Apart from the relative range restricted endemic species mentioned within the previous subsection, only three Threatened Red Data species have been recorded within the region according to the BODATSA-POSA data namely; *Drosanthemum calycinum* (Near Threatened), *Cliffortia arborea* (Vulnerable) and *Audouinia esterhuyseniae* (Vulnerable).

Furthermore, five species have been recorded that contain inadequate information to make an assessment of its risk of extinction (DDD), namely; *Hereroa concava*, *Plelargonium brevirostre*, *Thesium sonderianum*, *Schizoglossum aschersonum*, and *Haworthia marumiana*.

The POC assessment of these species is provided in Table 8 below:



**Table 8:** Flora of conservation significance potentially occurring in the project area according to SANBI's BODATSA-POSA online database.

Species Name	Threat Status	Description	Habitat Preference	Potential of Occurrence (POC)
<i>Anisodonteia malvastroides</i>	Range Restricted & Rare	Small perennial shrub	This species is endemic to the mountains of the Great Karoo, where it occurs in the Nuweveld and Sneeuwberg mountains between Beaufort West and Middelburg. - Mountain slopes, kloofs and crowns	Unlikely
<i>Crassula barbata</i>	Range Restricted	Short lived perennial (up to 2 years)	Only known from Victoria West region. Rocky slopes where these species are found in shaded areas and under shrubs.	Unlikely
<i>Selago magnakarooica</i>	Range Restricted	Perennial Dwarf Shrub	A species endemic to the Great Karoo with an extent of occurrence 21 499 km <sup>2</sup> . This species occurs patchily in rocky outcrops.	Possible
<i>Piarranthus comptus</i>	Range Restricted	Perennial Succulent Forb	Gravelly flats under bushes.	Highly Probable
<i>Euphorbia hypogaea</i>	Range Restricted	Perennial Succulent Forb	It occurs on flats with karroid shrubs, usually under or alongside the shelter of bushes.	Highly Probable
<i>Stomatium suaveolens</i>	Range Restricted	Perennial Succulent Forb	The species occurs on flat rock slabs and shallow pan in the Fraserburg – Sutherland – Williston region	Unlikely
<i>Gethyllis longistyla</i>	Range Restricted	Perennial Geophytic Forb	Sneeuwberg, Agter-Sneeuwberg and Nuweveld Mountains. High altitudes. Summits of rocky dolerite ridges.	Unlikely
<i>Drosanthemum calycinum</i>	NT	Perennial Succulent Forb	Lowland shale.	Unlikely
<i>Cliffortia arborea</i>	VU	Perennial Shrub	Hantamsberg Mountain to Nuweveld Mountains. Cliffs and ledges of dolerite, sandstone, and shale escarpment.	Unlikely
<i>Audouinia esterhuyseniae</i>	VU	Perennial Shrub	Hex River Mountains and Stettynsberg. Shale soil on	Highly Unlikely

			south-facing slopes below sandstone cliffs.	
<i>Hereroa concava</i>	Range Restricted & DDD	Perennial Succulent Forb	Plants occur sheltered among shrubs on flats and plateaus with shale outcrops.	Possible
<i>Pelargonium brevirostre</i>	DDD	Perennial Forb	Near watercourses	Unlikely
<i>Schizoglossum aschersonianum</i> var. <i>radiatum</i>	DDD	Perennial Forb	Unknown	Highly Unlikely
<i>Haworthia marumiana</i>	Range Restricted & DDD	Perennial Succulent Forb	Higher altitude, very often on steep rocky slopes. It prefers more shade position in rock crevices or under the bushes.	Unlikely

**Following the detailed field survey, no SCC were observed within the mining footprint as well as the immediate surrounding environment and as such this development will not have an impact on the status, distribution of any floral SCC.**

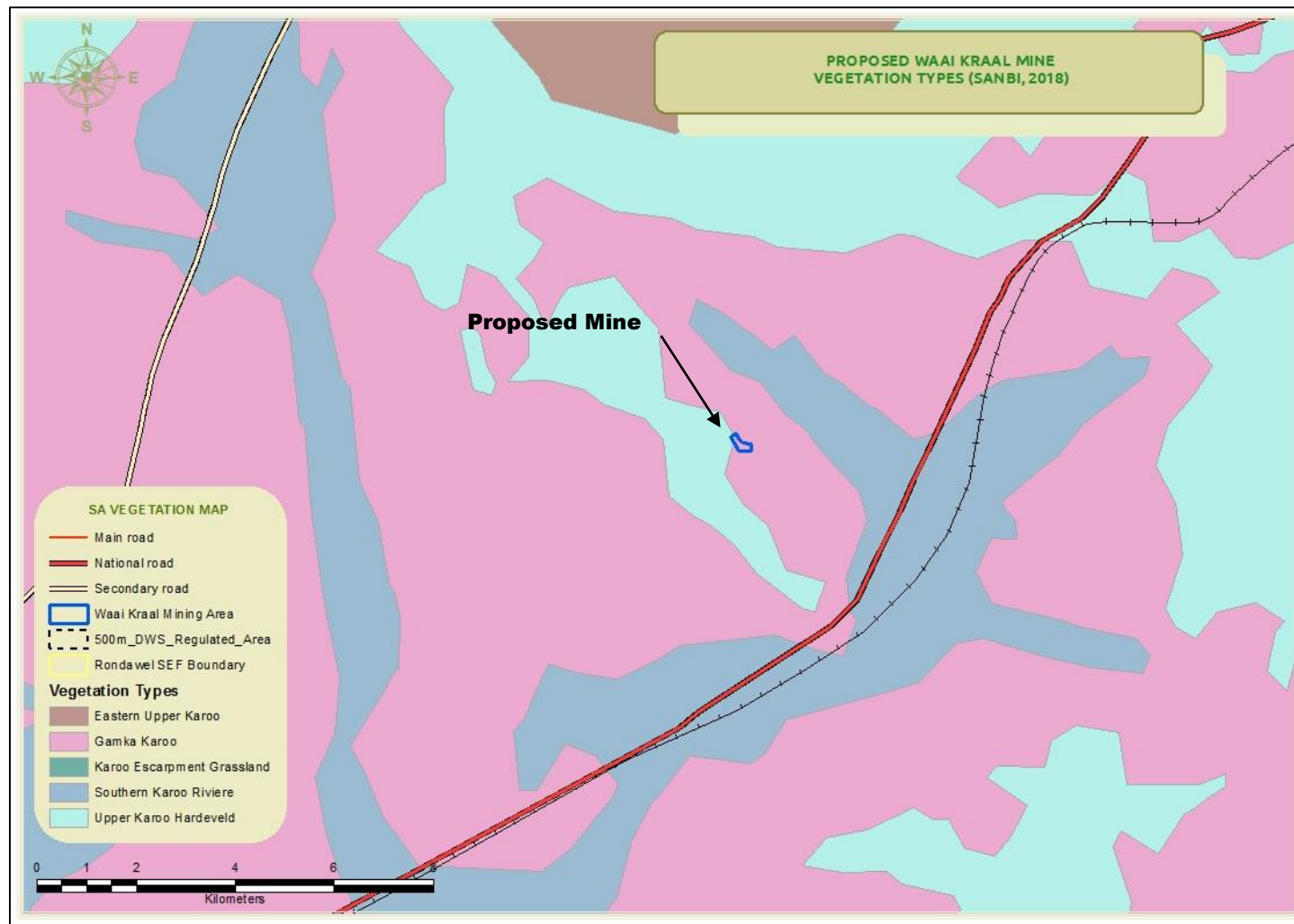


Figure 4: Map illustrating the different vegetation units found within the region.

### 5.3 Conservation Planning / Context

Understanding the conservation context and importance of the study area and surroundings is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial, and regional conservation planning information available and was used to obtain an overview of the study site (Table 9).

**Table 9:** Summary of the conservation context details for the study area.

Conservation Planning Dataset		Relevant Conservation Feature	Location in Relationship to Project Site	Conservation Planning Status
NATIONAL LEVEL CONSERVATION PLANNING CONTEXT	National Protected Areas Expansion Strategy	Focus Area	Outside of Focus Area: ± 11km east of an Upper Karoo Focus Area	Not Classified
	Protected Areas and Conservation Areas (PACA) Database	South African Conservation Area (SACA)	Well outside of any SACA:	Not Classified
		South African Protected Area (SAPA)	Located 17km north-east of Steenbokkie Private Nature Reserve and 26km east of Karoo National Park	Not Classified
	Vegetation Types	Upper Karoo Hardeveld	Vegetation of Study Area	Least Threatened
		Gamka Karoo	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Not listed as Threatened Ecosystem	Located outside of any Threatened Ecosystems	Not Classified
	National Freshwater Ecosystem Priority Area	River FEPA	Located outside of any River FEPAs	Not Classified
Wetland FEPA		No Wetland FEPAs located within project site.	Not Classified	
PROVINCIAL AND REGIONAL	WCBSP: Critical Biodiversity Areas	Other Natural Areas	Remaining natural areas of study area apart from transformed areas (roads)	ONA

#### 5.3.1 National Protected Areas Expansion Strategy

Focus areas for land-based protected area expansion are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. The focus areas were identified through a systematic biodiversity planning process undertaken as part of the development of the National Protected Area

Expansion Strategy 2008 (NPAES). They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with a strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine-scale planning which may identify a range of different priority sites based on local requirements, constraints, and opportunities.

According to the NPAES spatial data (Holness, 2010), the proposed mining footprint is located well outside of any Focus Area (FA), with the nearest FA located approximately 11km west of the proposed mining area (Figure 5). Subsequently, no NPAES Focus Areas will be impacted by the development.

### **5.3.2 National Protected Areas Expansion Strategy**

The South African Protected Areas Database (SAPAD) contains spatial data for the conservation estate of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. Data is collected by parcels which are aggregated to protected area level.

The definition of protected areas used in this document follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the "System of Protected Areas", which consists of the following kinds of protected areas –

- » Special nature reserves,
- » National parks,
- » Nature reserves and
- » Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003);
- » World heritage sites declared in terms of the World Heritage Convention Act;
- » Marine protected areas declared in terms of the Marine Living Resources Act;
- » Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998); and
- » Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

The types of conservation areas that are currently included in the database are the following:

- » Biosphere reserves
- » Ramsar sites
- » Stewardship agreements (other than nature reserves and protected environments)
- » Botanical gardens
- » Transfrontier conservation areas
- » Transfrontier parks
- » Military conservation areas
- » Conservancies

Taken together, protected areas and conservation areas make up the conservation estate.

According to the PACA database, no Conservation Areas (SACAs) or Protected Areas (SAPAs) are located in close proximity to the project site (Figure 5). The closest SAPA is the Steenbokkie Private Nature Reserve, located approximately 17km south-west of the proposed mining area. Furthermore, the Karoo National Park is located approximately 26km to the east of the proposed mining area.

Subsequently, the development poses no threat to any SACAs or SAPAs.

### 5.3.3 National Level of Conservation Priorities (Threatened Ecosystems)

The vegetation types of South Africa have been categorized according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale, these thresholds are as depicted in the table below, as determined by the best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

**Table 10:** Determining ecosystem status (from Driver et al. 2005). \*BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

A national process has been undertaken to identify and list threatened ecosystems that are currently under threat of being transformed by other land uses. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (National Environmental Management: Biodiversity Act or NEMBA: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011). The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function, and composition of threatened ecosystems (SANBI, 2011). The NEMBA provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. There are four main types of implications of listing ecosystems:

- » Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
- » Environmental authorisation implications in terms of NEMA and the EIA regulations;
- » Proactive management implications in terms of the National Biodiversity Act;
- » Monitoring and reporting implications in terms of the Biodiversity Act.

According to Mucina and Rutherford (2018), the Gamka Karoo vegetation type is classified as Least Threatened with a conservation target of 16% and with only 1.9% being conserved within statutory conservation areas. Very little of this vegetation type has been transformed with only 0.5% being transformed.

The situation for the Upper Karoo Hardeveld vegetation type is relative similar (Mucina and Rutherford, 2018) with a conservation target of 21% and with only 2.9% being conserved within statutory conservation areas. Furthermore, only 0.3% of this vegetation type has been transformed. Subsequently this vegetation types is also listed as Least Threatened (Table 11).

Furthermore, this area is **Not** listed (Figure 5) within the Threatened Ecosystem List (NEMA:BA).

It is highly unlikely that this development will have an impact on the status of the Vegetation Type due to the extent of the development.

**Table 11:** Conservation status of the vegetation types occurring in and around the proposed mining area.

Vegetation Type	Target (%)	Transformed (%)	Conserved (Statutorily & other reserves)	Conservation Status	
				Driver <i>et al.</i> , 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEMA:BA)
Gamka Karoo	16%	0.5%	1.9%	Least Threatened	Not Listed
Upper Karoo Hardeveld	21%	0.3%	2.9%	Least Threatened	Not Listed

### 5.3.4 Critical Biodiversity Areas and Broad Scale Ecological Processes

Critical Biodiversity Areas have been identified for all municipal areas of the Western Cape Province (CapeNature, 2017) and are published on the SANBI website (bgis.sanbi.org). This biodiversity assessment identifies CBAs which represent biodiversity priority areas that should be maintained in a natural to near-natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives (refer to Table 12 for the different land management objectives set out for each CBA category). According to these maps, large tracks of land within the region falls either within Other Natural Areas or Ecological Support Areas (ESA).

The entire mining footprint as well as the immediate surrounding environment is classified as Other Natural Area (Figure 6). Subsequently, the development poses no threat to any CBAs or ESAs.

**Table 12:** Relationship between Critical Biodiversity Areas categories (CBAs) and land management objectives

CBA category	Land Management Objective
Protected Areas (PA) & CBA 1	<p><b>Natural landscapes:</b></p> <ul style="list-style-type: none"> <li>» Ecosystems and species are <u>fully intact</u> and <u>undisturbed</u>.</li> <li>» These are areas with <u>high irreplaceability</u> or <u>low flexibility</u> in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met.</li> <li>» These are landscapes that are <u>at or past</u> their limits of acceptable change.</li> </ul>
CBA 2	<p><b>Near-natural landscapes:</b></p> <ul style="list-style-type: none"> <li>» Ecosystems and species <u>largely intact</u> and <u>undisturbed</u>.</li> <li>» Areas with <u>intermediate irreplaceability</u> or <u>some flexibility</u> in terms of the area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets.</li> <li>» These are landscapes that are <u>approaching but have not passed</u> their limits of acceptable change.</li> </ul>



<b>ESA</b>	<p><b>Functional landscapes:</b></p> <ul style="list-style-type: none"> <li>» Ecosystem <u>moderately to significantly disturbed</u> but still able to <u>maintain basic functionality</u>.</li> <li>» Individual species or other biodiversity indicators may be <u>severely disturbed or reduced</u>.</li> <li>» These are areas with <u>low irreplaceability</u> with respect to biodiversity pattern targets only.</li> </ul>
<b>ONA (Other Natural Areas) and Transformed</b>	<p>Production landscapes:                  Manage land to optimise sustainable utilisation of natural resources.</p>

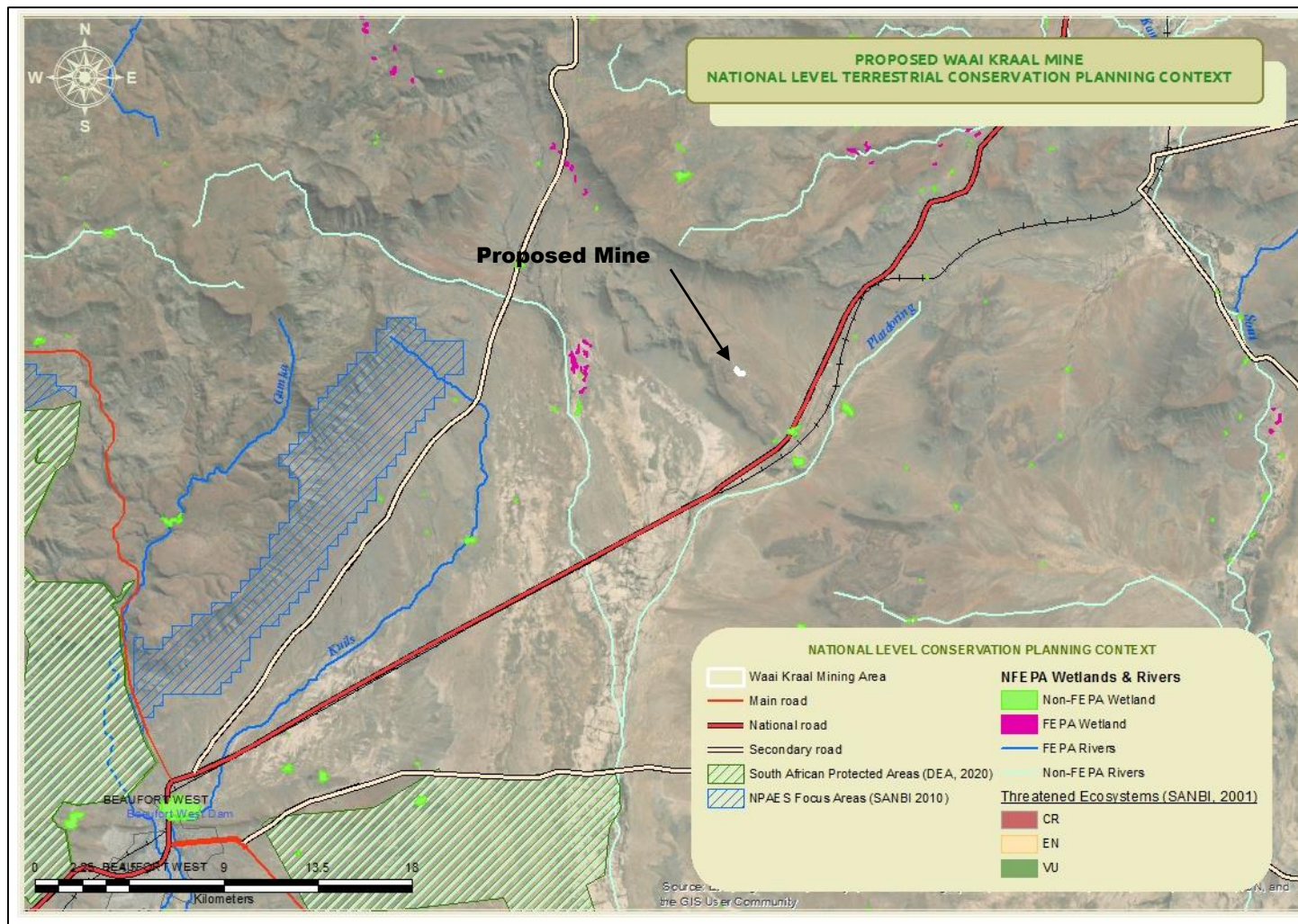


Figure 5: National Level Terrestrial Conservation Planning Context.

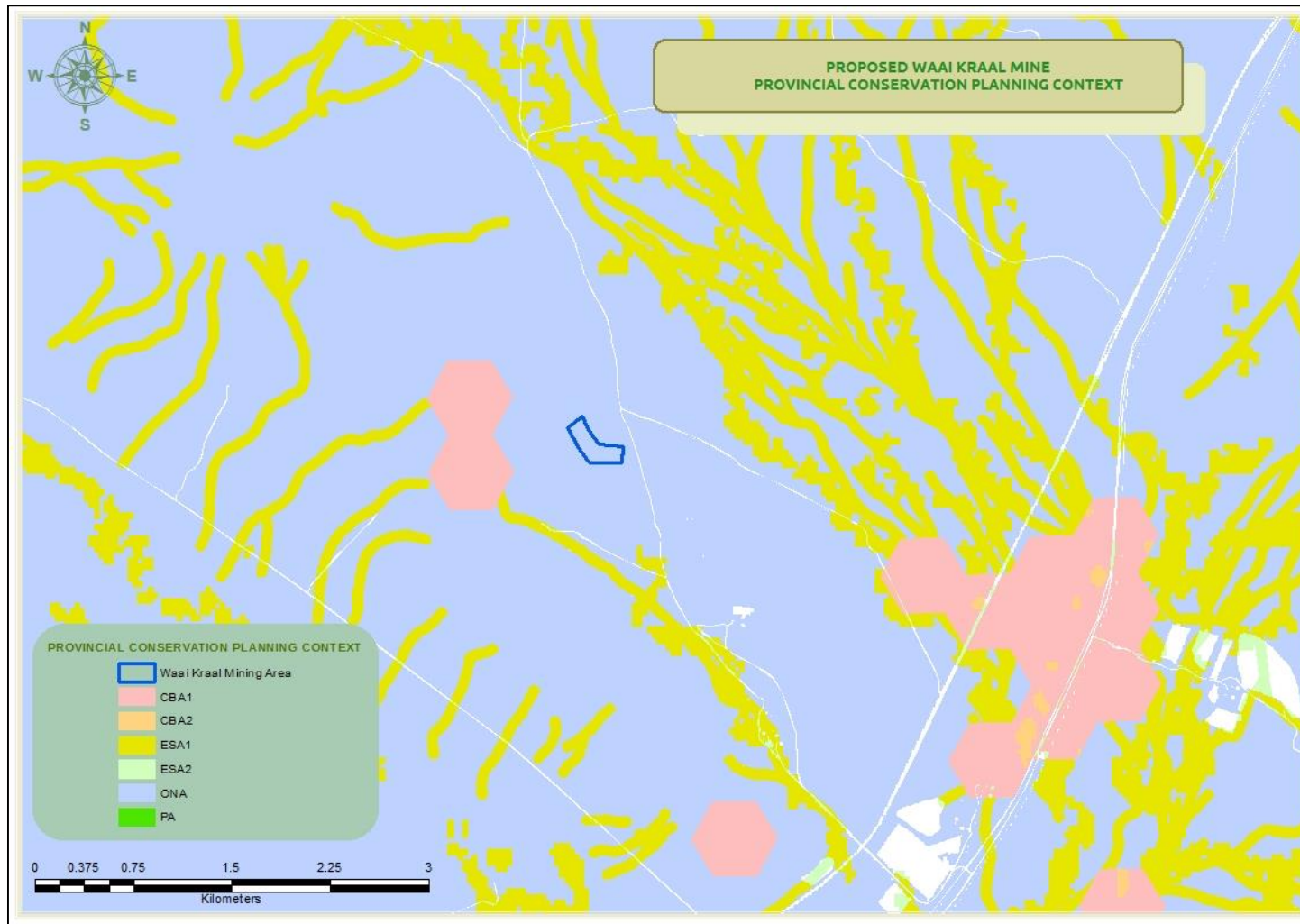


Figure 6: National Level Aquatic Conservation Planning Context.

## 5. FINDINGS OF THE BOTANICAL ASSESSMENT

### 6.1 Site Specific Vegetation Description - Fine Scale Vegetation Patterns

In this section, the different habitats and vegetation patterns observed within the study site are described. As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the results of the National Vegetation Map which is at a coarse scale and does not represent the detail of the site adequately. The habitat map derived for the study site is provided in Figure 7 and their sensitivity ratings are provided in Figure 8.

The vegetation within the mining area largely resembles that of the described Upper Karoo Hardeveld and is associated with the shallow, rocky soils of the dolerite outcrop. The eastern portion of the mining area extends into a lower lying gradual plain, which contain a vegetation assemblage which is consistent with a slightly modified (overgrazed) form of Gamka Karoo. Impacts on the vegetation of this area includes grazing (sheep and goat) and a farm track.

Two main habitat types were distinguished within the mining area and immediate surrounding environment namely the dolerite outcrop, dominated by dwarf shrubs and wiry grasses, and the karroid grassy plain dominated mostly by wiry grasses. Although there were some smaller scale variations in the plant communities present within the dolerite outcrop, notably due to edaphic factors such as soil depth, texture, moisture retention and surface rockiness the vegetation of the dolerite outcrop has been classified as a single habitat type and indeed the vegetation on site is relatively uniform overall. A feature worth noting within dolerite outcrop is however, the taller shrub patches located along the footslope and deeper sandy pockets.

A total of 82 plant species were recorded within the mining area with 76 species associated with the dolerite outcrop whilst 24 species were recorded within the plain habitat. All of species recorded were indigenous with no alien plants recorded within the mining area. The mining area can be characterized as a relative short, dwarf karroid shrubland dominated by dwarf shrubs (20 species) and forbs (21 species) and wiry white grass species (17 species). Even though succulence, within the mining area, is not well represented in terms of species diversity, succulent dwarf shrubs are a common coverage within the area. As mentioned, taller shrubs and small trees are associated with areas with a slightly higher moisture content along the footslopes and sandy pockets of the dolerite ridge. These taller shrub patches mostly comprise of *Searsia burchellii*, *Carissa bispinosa*, *Diospyros lyciodes* and *Grewia occidentalis*, with *Asparagus retrofractus* straggling into the branches of these taller shrubs. Plant families well represented within the mining area include; Asteraceae (19 species), Poaceae (17 species) and Fabaceae (8 species).


Key and dominant plants of the dolerite outcrop include:

- » Forbs: *Sericocoma avolans*, *Dichilus gracilis*, *Melolobium adenodes*
- » Dwarf Shrubs: *Asparagus striatus*, *Eriocephalus ericoides*, *Felicia muricata*, *Helichrysum lycilioides*, *Pteronia glomerata*, *Rosenia humilis*, *Rhigozum obovatum*, *Lotononis pungens*
- » Succulent Dwarf Shrub: *Ruschia intricata*
- » Graminoid: *Anthephora pubescens*, *Aristida congesta*, *A. diffusa*, *Enneapogon desvauxii*, *Eragrostis lehmanniana* and *E. obtusa*
- » Fern: *Ceterach cordatum*

Key and dominant plants of the karroid grassy plain include:

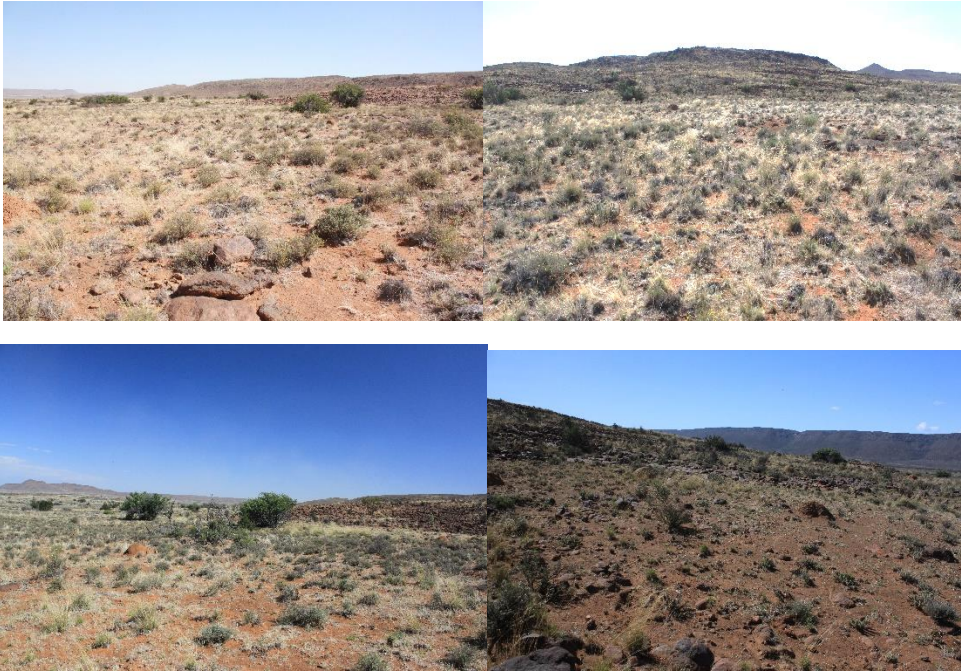
- » Forbs: *Aptosimum spinescens*
- » Dwarf Shrubs: *Pentzia incana*, *Eriocephalus ericoides* and *Pteronia glomerata*,
- » Succulent Dwarf Shrub: *Ruschia intricata*
- » Graminoid: *Aristida congesta* and *A. diffusa*,

**Table 13:** Summary of results for the Dolerite Ridge Habitat

<b>Dolerite Ridge</b>	<b>Habitat Sensitivity</b>	<b>Medium</b>	<b>Photographs:</b> 	
	<b>No-Go Areas</b>	None identified		
	<b>Present Ecological Status (PES)</b>	<b>B: Largely Natural with few modifications</b>		
<b>Substrate</b>	<ul style="list-style-type: none"> <li>» Soils poorly developed, shallow to absent.</li> <li>» Abundance of grit/gravel and larger stones</li> <li>» Larger boulders and exposed bedrock sheets in localised areas</li> </ul>			
<b>Species richness</b>	<b>Low: 76</b> Indigenous Species			
<b>Alien Invasive Plants</b>	<b>None recorded</b>			
<b>Species of Conservation Concern (SCC)</b>	<p>No SCC were recored.</p> <p>One provincially protected species was recorded namely:</p> <ul style="list-style-type: none"> <li>» <i>Babiana hypgeae</i>,</li> </ul>			
<b>Slope</b>	<ul style="list-style-type: none"> <li>» Generally in a north-eastern direction.</li> <li>» Micro variation in topography: Highly varying</li> </ul>			
<b>Disturbance</b>	<ul style="list-style-type: none"> <li>» Some grazing by sheep and goat.</li> <li>» Palatable dwarf shrubs have been significantly browsed.</li> </ul>	<b>Naturalness:</b>	<ul style="list-style-type: none"> <li>» Mostly natural and undisturbed.</li> </ul>	

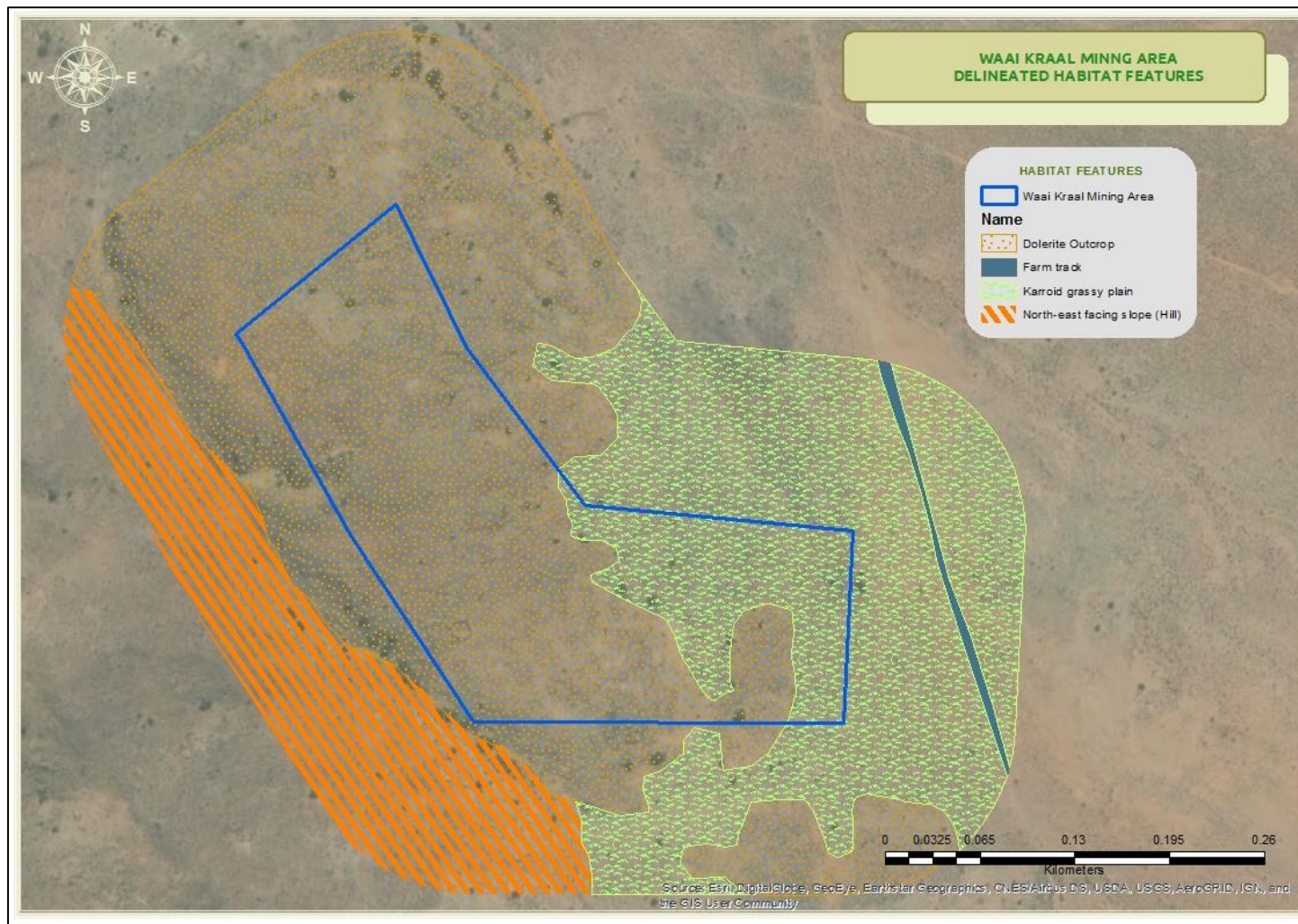
<b>Ecosystem Functions:</b>	<ul style="list-style-type: none"> <li>» Niche habitats for fauna – providing sheltered burrows and nesting sites</li> <li>» Niche habitats for specific flora species</li> <li>» Small-scale moisture retention under rocks enables long-term persistence of vegetation that can sustain fauna during dry periods</li> <li>» Larger shrubs and small trees patches provide nesting space for birds and shelter/breeding areas for fauna.</li> </ul>	<b>Conservation value</b>	<b>Moderate</b> <ul style="list-style-type: none"> <li>» Situated outside of any CBAs and ESAs</li> <li>» Situated outside of any NPAEs</li> <li>» Mostly natural habitat.</li> <li>» No Species of Conservation Concern or highly restricted species</li> <li>» On Provincially Protected plant: <i>Babiana hypogaeae</i></li> <li>» Low level of protected species.</li> </ul>
<b>Anthropogenic importance and potential</b>	<b>Agricultural Potential:</b> Moderate (Grazing)	<b>Conclusion and Mitigation Requirements</b>	<ul style="list-style-type: none"> <li>» This area is of a moderate ecological sensitivity.</li> <li>» Development activities within this area are allowed.</li> <li>» Development activities within this area are unlikely to have a significant impact on regional ecological functionality.</li> <li>» Operational activities should be restricted to the development footprint as indicated within this study.</li> <li>» No provincially protected species may be re-located / disturbed or destroyed without the necessary Permits in place (obtained from the relevant nature conservation authorities)</li> <li>» A vegetation rehabilitation and management plan is also vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated.</li> <li>» An invasive alien plant management plan should be compiled address the mitigation and management of such species throughout the operational phase as well as post-operational phase.</li> <li>» Rehabilitation progress, erosion and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annual for a minimum of two years.</li> </ul>
<b>Stability</b>	<ul style="list-style-type: none"> <li>» Herb layer will fluctuate during season</li> <li>» Shrub layer remains relatively stable if not excessively disturbed</li> </ul>		

**Table 14:** Summary of results for the Karroid Grassy Plains.

<b>Karroid Grassy Plain</b>	<b>Habitat Sensitivity</b>	<b>Medium</b>		<b>Photographs:</b>	
	<b>No-Go Areas</b>	None identified			
	<b>Present Ecological Status (PES)</b>	<b>C: Moderately Modified.</b>			
<b>Substrate</b>	» Undulating plains with fine grained deeper soils mixed with subsurface or surface rock fragments.				
<b>Species richness</b>	<b>Low: 24</b> Indigenous Species				
<b>Alien Invasive Plants</b>	<b>None recorded</b>				
<b>Species of Conservation Concern (SCC)</b>	No SCC were recored.				
<b>Slope</b>	» Gentle east to north-east slope				
<b>Disturbance</b>	» Grazing by sheep and goat. » Impacts of grazing (overgrazing) more prominent within this habitat. » Farm tracks		<b>Naturalness:</b>	» Moderately modified. » Some loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	
<b>Ecosystem Functions:</b>	» Deeper loose soils enable higher infiltration of rainfall and runoff from adjacent rocky areas » Potential denser perennial grass cover on plains may supply accessible grazing to fauna,		<b>Conservation value</b>	<b>Moderate</b> » Situated outside of any CBAs and ESAs » Situated outside of any NPAEs » Mostly natural habitat.	



	<ul style="list-style-type: none"> <li>» Deeper looser soils provide burrowing habitat for a variety of fauna</li> <li>» Disturbance will lead to excess dust and subsequent soil capping and erosion after rains, perennial grasses may be slow to re-establish unless rainfall seasons are favourable (i.e. sufficient follow-up rainfall events)</li> </ul>		<ul style="list-style-type: none"> <li>» No Species of Conservation Concern or highly restricted species.</li> <li>» No provincially protected species.</li> <li>» Low level of protected species.</li> </ul>
<b>Anthropogenic importance and potential</b>	<b>Agricultural Potential:</b> Moderate – Low (Grazing)	<b>Conclusion and Mitigation Requirements</b>	<ul style="list-style-type: none"> <li>» This area is of a low ecological sensitivity.</li> <li>» Development activities within this area are allowed.</li> <li>» Development activities within this area are unlikely to have a significant impact on regional ecological functionality.</li> <li>» Operational activities should be restricted to the development footprint as indicated within this study.</li> <li>» Existing access road should be used.</li> <li>» Vehicle traffic should be limited to minimise compaction of topsoils.</li> <li>» A vegetation rehabilitation and management plan is also vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated.</li> <li>» An invasive alien plant management plan should be compiled address the mitigation and management of such species throughout the operational phase as well as post-operational phase.</li> <li>» Rehabilitation progress, erosion and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annual for a minimum of two years.</li> </ul>
<b>Stability</b>	<ul style="list-style-type: none"> <li>» Herb layer will fluctuate during season</li> <li>» Shrub and tree layer remains relatively stable,</li> <li>» Medium to low if excessively disturbed</li> </ul>		



**Figure 7:** Map illustrating the habitat units identified within the study area.



**Figure 8:** Map illustrating the botanical sensitivity of the project site.

## 6. ASSESSMENT OF PROPOSED IMPACTS

### 7.1 Assumptions

The following is assumed and/or known:

- » A thorough botanical walkthrough of all footprint areas will be conducted to detect and relocate, where possible, all plant species of conservation concern by a suitably qualified botanist prior to commencement of activities.
- » Throughout the duration of the mining activities, the footprint will be routinely cleared of all alien invasive plants if detected.
- » The site establishment itself will be associated with clearing of vegetation within the footprint only.
- » After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.
- A weakened or absent vegetation layer not only exposes the soil surface but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

### 7.2 Localised vs. cumulative impacts: some explanatory notes

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type, and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other factors. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of development be kept as close together as possible.

Due to the extent of this proposed mining footprint this mining activity will have a **very limited contribution** to the cumulative impacts of the area and will **not**:

- » compromise the ecological functioning of the larger "natural" environment; and

- » disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

Excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains and intermittent drainage lines, and this could also have detrimental effects on the lower-lying areas.

- Rehabilitation and revegetation of all surfaces disturbed or altered during the operational phase are desirable.

Disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent rangelands.

- » A regular monitoring and eradication protocol must be part of all the developments' long-term management plans.

After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

### 7.3 Identification of Potential Botanical Impacts and Associated Activities

Potential botanical impacts resulting from the proposed project would stem from a variety of different activities and risk factors associated with the site-establishment and operation phases of the project including the following:

#### 7.3.1 Site-establishment and Operational Phase

- » Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purposes.
- » Site clearing and exploration activities for site establishment.
- » Vegetation clearing could impact locally listed plant species. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna and potentially the loss of faunal species, habitats, and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled developments are allowed to occur in the future) the loss of these vegetation communities and habitats may potentially lead to a change in the conservation status of the affected vegetation type as well as the ability of this vegetation type and associated features to fulfil its ecological responsibilities (functions).

- » Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may potentially impact the downstream watercourses and aquatic habitats. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
- » Invasion by alien plants may be attributed to excessive disturbance to vegetation, creating a window of opportunity for the establishment of these alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the project site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species.
- » Presence and operation of mining vehicles and machinery on the project site. This will create a physical impact as well as generate noise, potential pollution and other forms of disturbances at the site.
- » The facility will require management and if this is not done effectively, it could impact adjacent intact areas through impacts such as erosion and the invasion of alien plant species.

### 7.3.2 Cumulative Impacts

- » The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets.
- » Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna, avifauna, and flora and impair their ability to respond to environmental fluctuations.

## 7.4 Assessment of Impacts

The impacts identified above are assessed below, during the site-establishment and operation phases of the facility as well as before and after mitigation.

### 7.4.1 Assessment of impacts associated with Site-establishment and Operational Phases

#### **Impact 1:** *Potential Impacts on vegetation and listed and protected plant species*

**Impact Nature:** Vegetation clearing will lead to the loss of current habitat within the proposed mining footprint and is an inevitable consequence of this type of activity. The extent of this mining footprint is however very small and the vegetation type within the affected area has a relatively widespread distribution, subsequently the loss of local vegetation within the mining footprint would be of relatively minor significance when considered at a broad scale.

Furthermore, in terms of Species of Conservation Concern and species with a restricted distribution, no such species are located within the proposed mining area and the proposed development will subsequently not have an impact on such species.

One provincially protected species was observed within the mining footprint and will be impacted.

	Without Mitigation	With Mitigation
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Long-term (4)
<b>Magnitude</b>	Minor (2)	Minor (1)
<b>Probability</b>	Definite (5)	Highly Probable (4)
<b>Significance</b>	<b>Medium (40)</b>	<b>Low (24)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Low	Low
<b>Irreplaceable loss of resources</b>	Unlikely	Unlikely
<b>Can impacts be mitigated?</b>	Reasonably but with limited full restoration potential.	
<b>Residual Impacts</b>	Very limited in extent ( <b>Not Significant</b> ): » Likely in the form of an altered vegetation cover.	

**Impact 2: Potential increased erosion risk during and post-operational phase**

**Impact Nature:** During the operational phase, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. It is critically important that proper erosion control measures and structures are put in place and maintained over the lifespan of the project.

	Without Mitigation	With Mitigation
<b>Extent</b>	Local and immediate surroundings (2)	Local (1)
<b>Duration</b>	Long-term (4)	Short-term (1)
<b>Magnitude</b>	Low (4)	Minor (3)
<b>Probability</b>	Definite (5)	Probable (3)
<b>Significance</b>	<b>Medium (50)</b>	<b>Low (15)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Moderate	High
<b>Irreplaceable loss of resources</b>	Moderate potential	Unlikely
<b>Can impacts be mitigated?</b>	Yes, to a large extent	

<b>Residual Impacts</b>	The loss of fertile soil and soil capping resulting in areas that cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation, residual impacts will be <b>very low on existing natural areas</b> .
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**Impact 3: Increased alien plant invasion during the operational phase**

<b>Impact Nature:</b> Increased alien plant invasion is one of the greatest risk factors associated with this activity. The disturbed and bare ground that is likely to be present at the site during and after the operational phase would leave the site vulnerable to alien plant invasion during the operation phase if not managed. Furthermore, the National Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.		
	<b>Without Mitigation</b>	<b>With Mitigation</b>
<b>Extent</b>	Local and immediate surroundings (2)	Local (1)
<b>Duration</b>	Permanent (5)	Short-term (1)
<b>Magnitude</b>	Moderate (6)	Minor (2)
<b>Probability</b>	Highly Probable (4)	Probable (3)
<b>Significance</b>	<b>Medium (52)</b>	<b>Low (12)</b>
<b>Status</b>	Negative	Negative
<b>Reversibility</b>	Moderate	High
<b>Irreplaceable loss of resources</b>	Low Probability	Unlikely
<b>Can impacts be mitigated?</b>	Yes, to a large extent	
<b>Residual Impacts</b>	With appropriate mitigation such as regular monitoring and eradication residual impacts will be <b>very low</b> and will likely comprise of few alien plants establishing for short periods of time between monitoring and eradication phases.	

**7.4.2 Assessment of Cumulative Impacts**

**Cumulative Impact 1: Reduced ability to meet conservation obligations and targets**

<b>Impact Nature:</b> The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the Province's ability to meet its conservation targets.
The proposed development footprint is located outside of any CBA and ESA area as identified by the CapeNature (2017).



- » The closest CBA area is a CBA1 area located approximately 550m to the west of the proposed site and is regarded as an area in natural condition that are required to meet biodiversity targets for species, ecosystems or ecological process and infrastructure. Important features identified within this CBA are:
- Suitable habitat for Cape Mountain Zebra
  - Watercourse Protection – Great Karoo
  - Shale Gass SEA Very High Significance Terrestrial
- From a Floristic perspective this development will have no impact on the integrity of this CBA as this CBA is located within a plateau of a separate ridge/koppie system with its own micro-catchment, and it is highly unlikely that mining activities and their associated impacts will extend into this area due to the natural barrier created between the lower ridge system to be mined and the plateau of the steeper/higher ridge system. Subsequently this proposed development can not contribute significantly to the integrity of the identified CBA areas.
- » The closest ESA area is the ESA1 associated with the extensive and broad ephemeral wash located approximately 1.06km to the east of the proposed development footprint. ESAs are areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of CBAs, and are often vital for delivering ecosystem services. This area has been classified as an ESA due to the presence of the fairly extensive ephemeral wash system acting as an important freshwater resource, as well as an important corridor for the movement of faunal and floral species.
- It is unlikely that this proposed development will have an impact on downstream water resources due to the size of the development, distance from the freshwater resource and the relative low slope associated with the area between the mining area and the freshwater resource ( $\pm 2\%$ ). With effective mitigation measures in place, including erosion control, stormwater management, and mine rehabilitation; the natural to near-natural vegetation between the mining area and the ESA1 will be maintained and subsequently the ESA will not be impacted.

	<b>Overall impact of the proposed project considered in isolation</b>	<b>Cumulative impact of the project and other projects within the area</b>
<b>Extent</b>	Local (1)	Regional (2)
<b>Duration</b>	Long Term (4)	Long-Term (4)
<b>Magnitude</b>	Small (0)	Minor (2)
<b>Probability</b>	Very Improbable (1)	Highly Improbable (2)
<b>Significance</b>	<b>Low (5)</b>	<b>Low (16)</b>
<b>Status</b>	Neutral	Slightly Negative
<b>Reversibility</b>	Low	Low
<b>Irreplaceable loss of resources</b>	Highly unlikely	Unlikely
<b>Can impacts be mitigated?</b>	Yes, to a large extent	

**Cumulative Impact 2: Impacts on Broad-Scale Ecological Processes**

<b>Impact Nature:</b> Transformation of intact habitat could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.		
	<b>Overall impact of the proposed project considered in isolation</b>	<b>Cumulative impact of the project and other projects within the area</b>
<b>Extent</b>	Local (1)	Regional (2)
<b>Duration</b>	Long Term (4)	Long-Term (4)
<b>Magnitude</b>	Small (0)	Minor (2)
<b>Probability</b>	Very Improbable (1)	Highly Improbable (2)
<b>Significance</b>	<b>Low (5)</b>	<b>Low (16)</b>
<b>Status</b>	Neutral	Slightly Negative
<b>Reversibility</b>	Low	Low
<b>Irreplaceable loss of resources</b>	Highly unlikely	Unlikely
<b>Can impacts be mitigated?</b>	Yes, to a large extent	

**Cumulative Impact 3: Cumulative impacts due to other mines within the greater surroundings - Large-scale disturbance of indigenous vegetation**

<b>Impact Nature:</b> Cumulative loss of habitats (including sensitive habitats) and an increase in the fractured nature of the landscape may lead to the loss of features responsible for maintaining biodiversity and providing ecosystem goods and services and may potentially lead to;		
<ul style="list-style-type: none"> <li>» A change in the status of the affected vegetation type, subsequently also reducing the ability to meet national conservation obligations and targets;</li> <li>» A reduction in biodiversity and even the loss of some species from the area;</li> <li>» Fracturing and isolation of landscapes may cut off important migration routes and prevent genetic variability thus reducing "genetic health" which may, in turn, lead to weaker species incapable to adapt and react to potential environmental changes and consequently also to a reduction in biodiversity and the extinction of some species from certain areas;</li> <li>» Large-scale disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent agricultural land and rangelands.</li> </ul>		
	<b>Overall impact of the proposed project considered in isolation</b>	<b>Cumulative impact of the project and other projects within the area</b>
<b>Extent</b>	Local (1)	Regional (2)
<b>Duration</b>	Long Term (4)	Long Term (4)
<b>Magnitude</b>	Small (0)	Minor (1)

<b>Probability</b>	Highly Improbable (1)	Improbable (2)
<b>Significance</b>	<b>Low (5)</b>	<b>Low (14)</b>
<b>Status</b>	Neutral to slightly negative	Slightly Negative
<b>Reversibility</b>	Low	Low
<b>Irreplaceable loss of resources</b>	Unlikely	Low Probability
<b>Can impacts be mitigated?</b>	Yes, to a large extent	

## 7.5 Impact Mitigation and Management

IMPACT	MITIGATION
<b>Site-Establishment and Operation Phase</b>	
<p><b>Impact 1:</b> Potential Impacts on vegetation and listed and protected plant species</p>	<ul style="list-style-type: none"> <li>» Pre-construction walk-through of the final mining footprint, by a suitably qualified botanist, for species of conservation concern that would be affected (also to comply with the Northern Cape Nature Conservation Act and DENC/DAFF permit conditions).</li> <li>» Permits must be kept on-site and in the possession of the flora search and rescue team at all times.</li> <li>» Pre-construction environmental induction for all staff on site must be provided to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas, etc.</li> <li>» Contractor's EO must provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place.</li> <li>» Blanket clearing of vegetation must be limited to the proposed mining footprint and associated infrastructure. No clearing outside of the minimum required footprint to take place.</li> <li>» Topsoil must be stripped and stockpiled separately during site preparation and replaced over disturbed areas on completion</li> <li>» Ensure that laydown areas, construction camps, and other temporary use areas are located in areas of low sensitivity and are properly fenced or demarcated as appropriate and practically possible.</li> <li>» All vehicles to remain on demarcated roads and no unnecessary driving in the veld outside these areas should be allowed.</li> <li>» Regular dust suppression during operation.</li> <li>» No plants may be translocated or otherwise uprooted or disturbed for rehabilitation or other purposes without express permission from the Contractor's EO and without the relevant permits.</li> <li>» No fires must be allowed on-site.</li> <li>» After the operation, rehabilitate an acceptable vegetation layer according to rehabilitation recommendations as provided within a site-specific Rehabilitation Plan compiled by a suitably qualified botanist                         <ul style="list-style-type: none"> <li>○ Revegetation should occur naturally where topsoils were not severely altered</li> </ul> </li> </ul>

<p><b>Impact 3:</b> Potential increased erosion risk during and post-operational phase</p>	<ul style="list-style-type: none"> <li>» Any erosion problems within the borrow pit area as a result of the mining activities observed should be rectified immediately and monitored thereafter to ensure that they do not re-occur.</li> <li>» Mining within steep slopes will need to ensure that adequate slope protection is provided.</li> <li>» All bare areas resulting from the development should be re-vegetated, post-operation, with locally occurring species, to bind the soil and limit erosion potential.</li> <li>» Roads and other disturbed areas within the project area should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.</li> <li>» Silt/sediment traps/barriers should be used where there is a danger of topsoil or material stockpiles eroding and entering downstream drainage lines and other sensitive areas.</li> <li>» These sediment/silt barriers should be regularly maintained and cleared so as to ensure effective drainage of the areas</li> <li>» Topsoil should be removed and stored separately from subsoil. Topsoil should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.</li> <li>» Stockpiles must be protected from erosion, stored on flat areas where possible, and be surrounded by appropriate berms.</li> <li>» Any erosion points created during construction should be filled and stabilized immediately.</li> <li>» Practical phased development and vegetation clearing should be practiced so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods of time.</li> <li>» Construction of gabions and other stabilisation features must be undertaken to prevent erosion, where deemed necessary.</li> </ul>
<p><b>Impact 5:</b> Increased alien plant invasion during the operational phase</p>	<ul style="list-style-type: none"> <li>» Alien species must be removed from the site as per NEMBA requirements.</li> <li>» A suitable weed management strategy to be implemented in the construction and operation phases.</li> <li>» Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring.</li> </ul>

	<ul style="list-style-type: none"> <li>» When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels.</li> <li>» Clearing methods should aim to keep disturbance to a minimum and must be undertaken in accordance with relevant guidelines.</li> <li>» No planting or importing of any alien species to the site for landscaping, rehabilitation or any other purpose should be allowed.</li> </ul>
<b>Cumulative Impacts</b>	
<p><b>Cumulative Impact 1:</b> Reduced ability to meet conservation obligations and targets</p>	<ul style="list-style-type: none"> <li>» The activity footprints of various proposed mining locations in the area must be kept to a minimum and natural vegetation should be encouraged to return during the post-operational phase.</li> <li>» Reduce the footprint of mining areas within sensitive habitat types as much as possible.</li> <li>» Any erosion problems within the borrow pit area as a result of the mining activities observed should be rectified immediately and monitored thereafter to ensure that they do not re-occur</li> <li>» All bare areas resulting from the development should be re-vegetated, post-operation, with locally occurring species, to bind the soil and limit erosion potential.</li> <li>» Roads and other disturbed areas within the project area should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.</li> <li>» Silt/sediment traps/barriers should be used where there is a danger of topsoil or material stockpiles eroding and entering downstream drainage lines and other sensitive areas.</li> <li>» These sediment/silt barriers should be regularly maintained and cleared so as to ensure effective drainage of the areas</li> <li>» Practical phased development and vegetation clearing should be practiced so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods of time.</li> <li>» A suitable weed management strategy to be implemented in the construction and operation phases.</li> <li>» Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring.</li> </ul>

	<ul style="list-style-type: none"> <li>» When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels.</li> </ul>
<p><b>Cumulative Impact 2:</b> Impacts on Broad-Scale Ecological Processes</p>	<ul style="list-style-type: none"> <li>» The footprints of the individual mining areas should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas post-operational phase.</li> <li>» Reduce the footprint of mining areas within sensitive habitat types as much as possible.</li> </ul>
<p><b>Cumulative Impact 3:</b> Cumulative impacts due to upgrade of roads and nearby borrow pits - Large-scale disturbance of indigenous vegetation</p>	<ul style="list-style-type: none"> <li>» The footprints of the individual mining areas should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas post-operational phase.</li> <li>» Reduce the footprint of mining areas within sensitive habitat types as much as possible.</li> </ul>

## 7. CONCLUSION

The proposed mining footprint will be approximately 4.9 ha in extent and will be located on a portion of Portion 4 of the farm Waai Kraal No 120 situated in the Beaufort West magisterial district of the Western Cape Province.

The study area is situated in the Nama Karoo biome. The majority of the proposed site is located within the Gamka Karoo Vegetation Type whilst a small portion of the north-western corner of the site falls within the Upper Karoo Hardeveld Vegetation Type. Both of these vegetation types are listed as Least Concern by Mucina and Rutherford (2018) and is furthermore not listed within the Threatened Ecosystem List (NEM:BA). Furthermore, the study site itself is located outside of any CBAs and / ESAs according to the Western Cape CBA Spatial Data.

It is highly unlikely that this development will have an impact on the status of the Ecosystem and Vegetation Types due to the limited extent of the mine as well as the extent of natural vegetation surrounding the mining area. Furthermore, this mine will not have a significant impact on the services and functions provided by the surrounding natural habitats and development within this area is regarded as acceptable.

In terms of local-level biodiversity, the site is not exceptional and the site is not highly sensitive in this regard, as there are no Species of Conservation Concern or unique and range restricted species present within the proposed mining as well as no unique habitats which are not widely available in the wider landscape. As a result, the majority of impacts associated with the development of the site are likely to be local in nature and not of wider significance. Only one provincially protected species has been recorded within the proposed mining area namely *Babianna hypogaeae*. This species is however not regarded as rare and the loss of the affected individuals from the development footprint would not be of wider significance or compromise the viability of the local populations of these species.

In terms of the likely botanical impacts associated with the mine, impacts on vegetation during the operation phase are likely to be relatively moderate (rated mostly as medium significance prior to mitigation) and are difficult to mitigate as little can be done to avoid the large amounts of disturbance associated with this phase of the development. As the affected vegetation type is relatively widespread and the footprint area is regarded as limited, the impact on vegetation, as already mentioned, is likely to be of locally high intensity but is not considered to be of broader significance. Potential cumulative impacts are also furthermore regarded limited and of low significance.

Subsequently the proposed development area is largely well located in terms of avoiding sensitive receptors and the development will not compromise the survival of any specific flora



or terrestrial vertebrate species on the study area or beyond if mitigation measures are fully implemented.

**From a botanical perspective, no objective or motives (identification of impacts of high significance, etc.) were identified which would hinder the establishment of the proposed mine. Activities and Impacts are regarded as acceptable from a botanical perspective and will not cause detrimental impacts to the local flora, located within the affected area and surroundings. Therefore, it is the opinion of the specialist that the development may be authorised, subject to the implementation of the recommended mitigation measures.**

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## 9. APPENDICES

### Appendix 1: Plant Species List of the mining footprint and immediate surroundings

Family	Species	Growth Form	Dolerite Outcrop	Karroid Grassy Plain
Actanthaceae	<i>Blepharis mitrata</i>	Forb	X	X
Aizoaceae	<i>Mestoklema tuberosum</i>	Succulent Shrub	X	
Aizoaceae	<i>Plinthus karoocicus</i>	Dwarf Shrub	X	X
Aizoaceae	<i>Ruschia intricata</i>	Succulent Dwarf Shrub	X	X
Aizoaceae	<i>Trichodiadema setuliferum</i>	Succulent Forb	X	
Amaranthaceae	<i>Stachys cuneata</i>	Forb	X	X
Amaranthaceae	<i>Sericocoma avolans</i>	Forb	X	
Anacardiaceae	<i>Searsia burchellii</i>	Shrub	X	
Anacardiaceae	<i>Searsia lancea</i>	Small Tree	X	
Apocynaceae	<i>Carissa bispinosa</i>	Shrub	X	
Asparagaceae	<i>Asparagus burchellii</i>	Dwarf Shrub	X	
Asparagaceae	<i>Asparagus striatus</i>	Dwarf Shrub	X	
Asparagaceae	<i>Asparagus capensis</i>	Dwarf Shrub	X	X
Asparagaceae	<i>Asparagus retrofractus</i>	Shrub	X	
Asteraceae	<i>Arctotheca spp.</i>	Forb	X	
Asteraceae	<i>Berkheya carlinifolia</i>	Forb	X	
Asteraceae	<i>Curio radicans</i>	Succulent Forb	X	
Asteraceae	<i>Eriocephalus ericoides</i>	Dwarf Shrub	X	X
Asteraceae	<i>Felicia muricata</i>	Dwarf Shrub	X	X
Asteraceae	<i>Garuleum spp.</i>	Dwarf Shrub	X	
Asteraceae	<i>Gazania krebisana</i>	Forb	X	X
Asteraceae	<i>Geigeria ornativa</i>	Forb	X	X
Asteraceae	<i>Helichrysum lucilioides</i>	Dwarf Shrub	X	
Asteraceae	<i>Helichrysum teretifolium</i>	Forb	X	
Asteraceae	<i>Helichrysum zeyheri</i>	Dwarf Shrub	X	
Asteraceae	<i>Kleinia longiflora</i>	Succulent Shrub	X	
Asteraceae	<i>Pentzia incana</i>	Dwarf Shrub	X	X
Asteraceae	<i>Pentzia spaherocephala</i>	Dwarf Shrub	X	
Asteraceae	<i>Pteronia glomerata</i>	Dwarf Shrub	X	X
Asteraceae	<i>Rosenia humilis</i>	Dwarf Shrub	X	
Asteraceae	<i>Senesio spp.</i>	Succulent Forb		X
Asteraceae	<i>Ursinia spp.</i>	Forb	X	
Bignoniaceae	<i>Rhigozum obovatum</i>	Dwarf Shrub	X	
Brassicaceae	<i>Heliophila spp.</i>	Forb	X	
Celastraceae	<i>Gymnosporia buxifolia</i>	Shrub	X	

<b>Crassulaceae</b>	<i>Crassula capitella ssp. thyrsoiflora</i>	Succulent Forb	X	
<b>Crassulaceae</b>	<i>Crassula corallina</i>	Succulent Forb	X	
<b>Ebenaceae</b>	<i>Diospyros lycioides</i>	Shrub	X	
<b>Fabaceae</b>	<i>Acacia (Vachellia) karroo</i>	Small Tree	X	
<b>Fabaceae</b>	<i>Dichilus gracilis</i>	Forb	X	X
<b>Fabaceae</b>	<i>Indigofera alternans</i>	Forb	X	
<b>Fabaceae</b>	<i>Lessertia frutescens</i>	Forb	X	
<b>Fabaceae</b>	<i>Lessertia inflata</i>	Forb	X	
<b>Fabaceae</b>	<i>Lotononis pungens</i>	Dwarf Shrub	X	
<b>Fabaceae</b>	<i>Lotononis spp.</i>	Forb	X	
<b>Fabaceae</b>	<i>Melolobium adenodes</i>	Dwarf Shrub	X	
<b>Malvaceae</b>	<i>Grewia occidentalis</i>	Shrub	X	
<b>Malvaceae</b>	<i>Hermannia vestita</i>	Forb	X	
<b>Poaceae</b>	<i>Antheophora pubescens</i>	Graminoid	X	
<b>Poaceae</b>	<i>Aristida congesta</i>	Graminoid	X	X
<b>Poaceae</b>	<i>Aristida diffusa</i>	Graminoid	X	X
<b>Poaceae</b>	<i>Cenchrus ciliaris</i>	Graminoid	X	
<b>Poaceae</b>	<i>Digitaria eriantha</i>	Graminoid	X	
<b>Poaceae</b>	<i>Enneapogon desvauxii</i>	Graminoid	X	X
<b>Poaceae</b>	<i>Enneapogon scaber</i>	Graminoid	X	
<b>Poaceae</b>	<i>Eragrostis curvula</i>	Graminoid		X
<b>Poaceae</b>	<i>Eragrostis obtusa</i>	Graminoid	X	
<b>Poaceae</b>	<i>Heteropogon contortus</i>	Graminoid	X	
<b>Poaceae</b>	<i>Melenis nerviglumis</i>	Graminoid	X	
<b>Poaceae</b>	<i>Oropetium capense</i>	Graminoid	X	
<b>Pteridaceae</b>	<i>Ceterach cordatum</i>	Fern	X	
<b>Pteridaceae</b>	<i>Pallaea calomelanos</i>	Fern	X	
<b>Ranunculaceae</b>	<i>Clematis brachiata</i>	Climbing Shrub	X	
<b>Rubiaceae</b>	<i>Nenax microphylla</i>	Dwarf Shrub	X	
<b>Scrophulariaceae</b>	<i>Aptosimum spinescens</i>	Forb		X
<b>Scrophulariaceae</b>	<i>Aptosimum indivisum</i>	Forb	X	
<b>Verbenaceae</b>	<i>Chascanum pinnatifidum</i>	Forb	X	
<b>Bignoniaceae</b>	<i>Rhigozum trichotomum</i>	Dwarf Shrub	X	X
<b>Poaceae</b>	<i>Eragrostis lehmanniana</i>	Graminoid	X	X
<b>Hyacinthaceae</b>	<i>Ledebouria spp. (ensifolia?)</i>	Geophyte	X	
<b>Iridaceae</b>	<i>Babiana spp. (hypgaea?)</i>	Geophyte	X	
<b>Asteraceae</b>	<i>Eriocephalus microcephalus</i>	Dwarf Shrub	X	
<b>Poaceae</b>	<i>Tragus berteronianus</i>	Graminoid	X	X
<b>Poaceae</b>	<i>Aristida adsecnsionis</i>	Graminoid		X
<b>Poaceae</b>	<i>Stipagrostis obtusa</i>	Graminoid		X
<b>Poaceae</b>	<i>Pentachistis airoides</i>	Graminoid	X	
<b>Cucurbitaceae</b>	<i>Kedrosistis africana</i>	Climbing Forb	X	

<b>Malvaceae</b>	<i>Hermannia cenua</i>	Forb	X	
<b>Malvaceae</b>	<i>Hermannia coccocarpa</i>	Forb	X	
<b>Aizoaceae</b>	<i>Drosanthemum lique</i>	Succulent Dwarf Shrub	X	
<b>Thymelaeaceae</b>	<i>Lasiosiphon polycephalus</i>	Dwarf Shrub		X
<b>Euphorbiaceae</b>	<i>Euphorbia rhombifolia</i>	Succulent Shrub	X	

## Appendix 2: Plant Species List of the region (POSA Generated List)

Family	Species	Rank1	Sp2
Acanthaceae	<i>Barleria stimulans</i>		
Acanthaceae	<i>Blepharis mitrata</i>		
Acanthaceae	<i>Justicia incana</i>		
Acanthaceae	<i>Justicia spartioides</i>		
Achariaceae	<i>Guthriea capensis</i>		
Achariaceae	<i>Kiggelaria africana</i>		
Aizoaceae	<i>Aizoon glinoides</i>		
Aizoaceae	<i>Aloinopsis rosulata</i>		
Aizoaceae	<i>Antimima sp.</i>		
Aizoaceae	<i>Chasmatophyllum musculinum</i>		
Aizoaceae	<i>Delosperma lootsbergense</i>		
Aizoaceae	<i>Delosperma sp.</i>		
Aizoaceae	<i>Drosanthemum calycinum</i>		
Aizoaceae	<i>Drosanthemum hispidum</i>		
Aizoaceae	<i>Drosanthemum lique</i>		
Aizoaceae	<i>Drosanthemum sp.</i>		
Aizoaceae	<i>Drosanthemum vespertinum</i>		
Aizoaceae	<i>Galenia africana</i>		
Aizoaceae	<i>Galenia glandulifera</i>		
Aizoaceae	<i>Galenia papulosa</i>		
Aizoaceae	<i>Galenia procumbens</i>		
Aizoaceae	<i>Galenia sarcophylla</i>		
Aizoaceae	<i>Hereroa concava</i>		
Aizoaceae	<i>Malephora thunbergii</i>		
Aizoaceae	<i>Mesembryanthemum articulatum</i>		
Aizoaceae	<i>Mesembryanthemum coriarium</i>		
Aizoaceae	<i>Mesembryanthemum crystallinum</i>		
Aizoaceae	<i>Mesembryanthemum emarcidum</i>		
Aizoaceae	<i>Mesembryanthemum excavatum</i>		
Aizoaceae	<i>Mesembryanthemum geniculiflorum</i>		
Aizoaceae	<i>Mesembryanthemum granulicaule</i>		
Aizoaceae	<i>Mesembryanthemum grossum</i>		
Aizoaceae	<i>Mesembryanthemum guerichianum</i>		
Aizoaceae	<i>Mesembryanthemum inachabense</i>		
Aizoaceae	<i>Mesembryanthemum noctiflorum</i>	subsp.	<i>noctiflorum</i>
Aizoaceae	<i>Mesembryanthemum noctiflorum</i>	subsp.	<i>stramineum</i>
Aizoaceae	<i>Mesembryanthemum oubergense</i>		
Aizoaceae	<i>Mesembryanthemum stenandrum</i>		
Aizoaceae	<i>Mesembryanthemum tetragonum</i>		

<b>Aizoaceae</b>	<i>Mestoklema arboriforme</i>		
<b>Aizoaceae</b>	<i>Mestoklema tuberosum</i>		
<b>Aizoaceae</b>	<i>Plinthus karoicus</i>		
<b>Aizoaceae</b>	<i>Ruschia altigena</i>		
<b>Aizoaceae</b>	<i>Ruschia hamata</i>		
<b>Aizoaceae</b>	<i>Ruschia intricata</i>		
<b>Aizoaceae</b>	<i>Ruschia sp.</i>		
<b>Aizoaceae</b>	<i>Ruschia spinosa</i>		
<b>Aizoaceae</b>	<i>Schlechteranthus spinescens</i>		
<b>Aizoaceae</b>	<i>Stomatium sp.</i>		
<b>Aizoaceae</b>	<i>Stomatium suaveolens</i>		
<b>Aizoaceae</b>	<i>Stomatium villetii</i>		
<b>Aizoaceae</b>	<i>Tetragonia arbuscula</i>		
<b>Aizoaceae</b>	<i>Tetragonia robusta</i>		
<b>Aizoaceae</b>	<i>Tetragonia spicata</i>		
<b>Aizoaceae</b>	<i>Trianthema parvifolia</i>	var.	<i>parvifolia</i>
<b>Aizoaceae</b>	<i>Trichodiadema barbatum</i>		
<b>Aizoaceae</b>	<i>Trichodiadema intonsum</i>		
<b>Aizoaceae</b>	<i>Trichodiadema setuliferum</i>		
<b>Aizoaceae</b>	<i>Trichodiadema sp.</i>		
<b>Alliaceae</b>	<i>Tulbaghia leucantha</i>		
<b>Amaranthaceae</b>	<i>Atriplex lindleyi</i>	subsp.	<i>inflata</i>
<b>Amaranthaceae</b>	<i>Atriplex nummularia</i>	subsp.	<i>nummularia</i>
<b>Amaranthaceae</b>	<i>Atriplex semibaccata</i>		
<b>Amaranthaceae</b>	<i>Chenopodium schraderianum</i>		
<b>Amaranthaceae</b>	<i>Salsola aphylla</i>		
<b>Amaranthaceae</b>	<i>Salsola atrata</i>		
<b>Amaranthaceae</b>	<i>Salsola dealata</i>		
<b>Amaranthaceae</b>	<i>Salsola kali</i>		
<b>Amaranthaceae</b>	<i>Salsola minutifolia</i>		
<b>Amaranthaceae</b>	<i>Salsola rabieana</i>		
<b>Amaranthaceae</b>	<i>Salsola seminuda</i>		
<b>Amaranthaceae</b>	<i>Sericocoma avolans</i>		
<b>Amaryllidaceae</b>	<i>Gethyllis longistyla</i>		
<b>Amaryllidaceae</b>	<i>Gethyllis transkarooica</i>		
<b>Amaryllidaceae</b>	<i>Haemanthus humilis</i>	subsp.	<i>humilis</i>
<b>Anacampserotaceae</b>	<i>Anacampseros filamentosa</i>	subsp.	<i>filamentosa</i>
<b>Anacampserotaceae</b>	<i>Anacampseros lanceolata</i>	subsp.	<i>lanceolata</i>
<b>Anacardiaceae</b>	<i>Searsia burchellii</i>		
<b>Anacardiaceae</b>	<i>Searsia lancea</i>		
<b>Anacardiaceae</b>	<i>Searsia pallens</i>		
<b>Anacardiaceae</b>	<i>Searsia pyroides</i>	var.	<i>pyroides</i>



<b>Anacardiaceae</b>	<i>Searsia undulata</i>		
<b>Apiaceae</b>	<i>Berula thunbergii</i>		
<b>Apiaceae</b>	<i>Chamarea longipedicellata</i>		
<b>Apiaceae</b>	<i>Heteromorpha arborescens</i>	var.	<i>arborescens</i>
<b>Apiaceae</b>	<i>Notobubon laevigatum</i>		
<b>Apocynaceae</b>	<i>Brachystelma circinatum</i>		
<b>Apocynaceae</b>	<i>Carissa bispinosa</i>		
<b>Apocynaceae</b>	<i>Ceropegia stapeliiformis</i>	subsp.	<i>stapeliiformis</i>
<b>Apocynaceae</b>	<i>Duvalia maculata</i>		
<b>Apocynaceae</b>	<i>Duvalia sp.</i>		
<b>Apocynaceae</b>	<i>Gomphocarpus filiformis</i>		
<b>Apocynaceae</b>	<i>Gomphocarpus fruticosus</i>	subsp.	<i>fruticosus</i>
<b>Apocynaceae</b>	<i>Gomphocarpus tomentosus</i>	subsp.	<i>tomentosus</i>
<b>Apocynaceae</b>	<i>Huernia barbata</i>	subsp.	<i>barbata</i>
<b>Apocynaceae</b>	<i>Huernia thuretii</i>		
<b>Apocynaceae</b>	<i>Microloma armatum</i>	var.	<i>armatum</i>
<b>Apocynaceae</b>	<i>Piранthus comptus</i>		
<b>Apocynaceae</b>	<i>Piранthus geminatus</i>	subsp.	<i>geminatus</i>
<b>Apocynaceae</b>	<i>Schizoglossum aschersonianum</i>	var.	<i>longipes</i>
<b>Apocynaceae</b>	<i>Schizoglossum bidens</i>	subsp.	<i>bidens</i>
<b>Apocynaceae</b>	<i>Stapelia grandiflora</i>	var.	<i>grandiflora</i>
<b>Apocynaceae</b>	<i>Stapelia sp.</i>		
<b>Apocynaceae</b>	<i>Tridentea jucunda</i>		
<b>Apocynaceae</b>	<i>Xysmalobium gomphocarpoides</i>	var.	<i>gomphocarpoides</i>
<b>Apocynaceae</b>	<i>Xysmalobium gomphocarpoides</i>	var.	<i>parvilobum</i>
<b>Araliaceae</b>	<i>Cussonia paniculata</i>	subsp.	<i>paniculata</i>
<b>Asparagaceae</b>	<i>Asparagus aethiopicus</i>		
<b>Asparagaceae</b>	<i>Asparagus burchellii</i>		
<b>Asparagaceae</b>	<i>Asparagus capensis</i>	var.	<i>capensis</i>
<b>Asparagaceae</b>	<i>Asparagus exuvialis</i>		
<b>Asparagaceae</b>	<i>Asparagus laricinus</i>		
<b>Asparagaceae</b>	<i>Asparagus lignosus</i>		
<b>Asparagaceae</b>	<i>Asparagus mucronatus</i>		
<b>Asparagaceae</b>	<i>Asparagus retrofractus</i>		
<b>Asparagaceae</b>	<i>Asparagus sp.</i>		
<b>Asparagaceae</b>	<i>Asparagus striatus</i>		
<b>Asparagaceae</b>	<i>Asparagus suaveolens</i>		
<b>Asphodelaceae</b>	<i>Aloe broomii</i>	var.	<i>broomii</i>
<b>Asphodelaceae</b>	<i>Aloe claviflora</i>		
<b>Asphodelaceae</b>	<i>Aloe humilis</i>		
<b>Asphodelaceae</b>	<i>Astroloba foliolosa</i>		
<b>Asphodelaceae</b>	<i>Bulbine abyssinica</i>		

<b>Asphodelaceae</b>	<i>Bulbine frutescens</i>		
<b>Asphodelaceae</b>	<i>Bulbine lagopus</i>		
<b>Asphodelaceae</b>	<i>Bulbine narcissifolia</i>		
<b>Asphodelaceae</b>	<i>Bulbine sp.</i>		
<b>Asphodelaceae</b>	<i>Bulbine triebneri</i>		
<b>Asphodelaceae</b>	<i>Gasteria disticha</i>	var.	<i>disticha</i>
<b>Asphodelaceae</b>	<i>Gasteria sp.</i>		
<b>Asphodelaceae</b>	<i>Haworthia marumiana</i>	var.	<i>marumiana</i>
<b>Asphodelaceae</b>	<i>Haworthia semiviva</i>		
<b>Asphodelaceae</b>	<i>Haworthiopsis fasciata</i>		
<b>Asphodelaceae</b>	<i>Haworthiopsis nigra</i>	var.	<i>diversifolia</i>
<b>Asphodelaceae</b>	<i>Haworthiopsis nigra</i>	var.	<i>nigra</i>
<b>Asphodelaceae</b>	<i>Haworthiopsis tessellata</i>	var.	<i>tessellata</i>
<b>Asphodelaceae</b>	<i>Haworthiopsis tessellata</i>		
<b>Asphodelaceae</b>	<i>Trachyandra acocksii</i>		
<b>Asphodelaceae</b>	<i>Trachyandra jacquiniana</i>		
<b>Aspleniaceae</b>	<i>Asplenium adiantum-nigrum</i>	var.	<i>adiantum-nigrum</i>
<b>Aspleniaceae</b>	<i>Asplenium cordatum</i>		
<b>Aspleniaceae</b>	<i>Asplenium trichomanes</i>	subsp.	<i>quadrivalens</i>
<b>Asteraceae</b>	<i>Arctotis arctotoides</i>		
<b>Asteraceae</b>	<i>Arctotis dregei</i>		
<b>Asteraceae</b>	<i>Arctotis leiocarpa</i>		
<b>Asteraceae</b>	<i>Arctotis microcephala</i>		
<b>Asteraceae</b>	<i>Arctotis subacaulis</i>		
<b>Asteraceae</b>	<i>Athanasia microcephala</i>		
<b>Asteraceae</b>	<i>Berkheya carlinifolia</i>		
<b>Asteraceae</b>	<i>Berkheya glabrata</i>		
<b>Asteraceae</b>	<i>Caputia tomentosa</i>		
<b>Asteraceae</b>	<i>Chrysocoma ciliata</i>		
<b>Asteraceae</b>	<i>Chrysocoma sp.</i>		
<b>Asteraceae</b>	<i>Cineraria aspera</i>		
<b>Asteraceae</b>	<i>Cineraria mollis</i>		
<b>Asteraceae</b>	<i>Conyza scabrada</i>		
<b>Asteraceae</b>	<i>Cotula microglossa</i>		
<b>Asteraceae</b>	<i>Curio articulatus</i>		
<b>Asteraceae</b>	<i>Curio radicans</i>		
<b>Asteraceae</b>	<i>Dicrothamnus rhinocerotis</i>		
<b>Asteraceae</b>	<i>Dicoma picta</i>		
<b>Asteraceae</b>	<i>Dimorphotheca cuneata</i>		
<b>Asteraceae</b>	<i>Dimorphotheca sp.</i>		
<b>Asteraceae</b>	<i>Eriocephalus africanus</i>	var.	<i>paniculatus</i>
<b>Asteraceae</b>	<i>Eriocephalus ericoides</i>	subsp.	<i>ericoides</i>

<b>Asteraceae</b>	<i>Eriocephalus eximius</i>		
<b>Asteraceae</b>	<i>Eriocephalus microcephalus</i>		
<b>Asteraceae</b>	<i>Eriocephalus spinescens</i>		
<b>Asteraceae</b>	<i>Eriocephalus tenuifolius</i>		
<b>Asteraceae</b>	<i>Eumorphia corymbosa</i>		
<b>Asteraceae</b>	<i>Euryops anthemoides</i>	subsp.	<i>anthemoides</i>
<b>Asteraceae</b>	<i>Euryops cuneatus</i>		
<b>Asteraceae</b>	<i>Euryops empetrifolius</i>		
<b>Asteraceae</b>	<i>Euryops imbricatus</i>		
<b>Asteraceae</b>	<i>Euryops lateriflorus</i>		
<b>Asteraceae</b>	<i>Euryops oligoglossus</i>	subsp.	<i>oligoglossus</i>
<b>Asteraceae</b>	<i>Euryops subcarnosus</i>	subsp.	<i>vulgaris</i>
<b>Asteraceae</b>	<i>Felicia fascicularis</i>		
<b>Asteraceae</b>	<i>Felicia filifolia</i>	subsp.	<i>bodkinii</i>
<b>Asteraceae</b>	<i>Felicia filifolia</i>	subsp.	<i>filifolia</i>
<b>Asteraceae</b>	<i>Felicia hirsuta</i>		
<b>Asteraceae</b>	<i>Felicia hyssopifolia</i>	subsp.	<i>polyphylla</i>
<b>Asteraceae</b>	<i>Felicia muricata</i>	subsp.	<i>muricata</i>
<b>Asteraceae</b>	<i>Felicia namaquana</i>		
<b>Asteraceae</b>	<i>Felicia ovata</i>		
<b>Asteraceae</b>	<i>Felicia sp.</i>		
<b>Asteraceae</b>	<i>Garuleum bipinnatum</i>		
<b>Asteraceae</b>	<i>Gazania heterochaeta</i>		
<b>Asteraceae</b>	<i>Gazania krebsiana</i>		
<b>Asteraceae</b>	<i>Gazania krebsiana</i>	subsp.	<i>arctotoides</i>
<b>Asteraceae</b>	<i>Gazania krebsiana</i>	subsp.	<i>serrulata</i>
<b>Asteraceae</b>	<i>Gazania lichtensteinii</i>		
<b>Asteraceae</b>	<i>Gazania rigida</i>		
<b>Asteraceae</b>	<i>Gazania sp.</i>		
<b>Asteraceae</b>	<i>Geigeria filifolia</i>		
<b>Asteraceae</b>	<i>Geigeria ornativa</i>	subsp.	<i>ornativa</i>
<b>Asteraceae</b>	<i>Gerbera piloselloides</i>		
<b>Asteraceae</b>	<i>Gnaphalium capense</i>		
<b>Asteraceae</b>	<i>Gorteria alienata</i>		
<b>Asteraceae</b>	<i>Helichrysum asperum</i>	var.	<i>apressifolium</i>
<b>Asteraceae</b>	<i>Helichrysum caespitium</i>		
<b>Asteraceae</b>	<i>Helichrysum dregeanum</i>		
<b>Asteraceae</b>	<i>Helichrysum hamulosum</i>		
<b>Asteraceae</b>	<i>Helichrysum lineare</i>		
<b>Asteraceae</b>	<i>Helichrysum lucilioides</i>		
<b>Asteraceae</b>	<i>Helichrysum pumilio</i>	subsp.	<i>pumilio</i>
<b>Asteraceae</b>	<i>Helichrysum rugulosum</i>		

<b>Asteraceae</b>	<i>Helichrysum scitulum</i>		
<b>Asteraceae</b>	<i>Helichrysum sp.</i>		
<b>Asteraceae</b>	<i>Helichrysum trilineatum</i>		
<b>Asteraceae</b>	<i>Helichrysum zeyheri</i>		
<b>Asteraceae</b>	<i>Hertia ciliata</i>		
<b>Asteraceae</b>	<i>Lactuca inermis</i>		
<b>Asteraceae</b>	<i>Leysera gnaphalodes</i>		
<b>Asteraceae</b>	<i>Leysera tenella</i>		
<b>Asteraceae</b>	<i>Mantisalca salmantica</i>		
<b>Asteraceae</b>	<i>Oedera glandulosa</i>		
<b>Asteraceae</b>	<i>Oedera humilis</i>		
<b>Asteraceae</b>	<i>Oedera oppositifolia</i>		
<b>Asteraceae</b>	<i>Oedera spinescens</i>		
<b>Asteraceae</b>	<i>Oncosiphon piluliferus</i>		
<b>Asteraceae</b>	<i>Osteospermum calendulaceum</i>		
<b>Asteraceae</b>	<i>Osteospermum microphyllum</i>		
<b>Asteraceae</b>	<i>Osteospermum muricatum</i>	subsp.	<i>muricatum</i>
<b>Asteraceae</b>	<i>Osteospermum scariosum</i>	var.	<i>integrifolium</i>
<b>Asteraceae</b>	<i>Osteospermum scariosum</i>	var.	<i>scariosum</i>
<b>Asteraceae</b>	<i>Osteospermum sinuatum</i>	var.	<i>sinuatum</i>
<b>Asteraceae</b>	<i>Othonna eriocarpa</i>		
<b>Asteraceae</b>	<i>Othonna furcata</i>		
<b>Asteraceae</b>	<i>Othonna pavonia</i>		
<b>Asteraceae</b>	<i>Othonna sp.</i>		
<b>Asteraceae</b>	<i>Pegolettia retrofracta</i>		
<b>Asteraceae</b>	<i>Pentzia calcarea</i>		
<b>Asteraceae</b>	<i>Pentzia incana</i>		
<b>Asteraceae</b>	<i>Pentzia lanata</i>		
<b>Asteraceae</b>	<i>Pentzia punctata</i>		
<b>Asteraceae</b>	<i>Pentzia quinquefida</i>		
<b>Asteraceae</b>	<i>Phymaspermum aciculare</i>		
<b>Asteraceae</b>	<i>Phymaspermum parvifolium</i>		
<b>Asteraceae</b>	<i>Phymaspermum thymelaeoides</i>		
<b>Asteraceae</b>	<i>Pseudognaphalium luteoalbum</i>		
<b>Asteraceae</b>	<i>Pseudognaphalium undulatum</i>		
<b>Asteraceae</b>	<i>Pteronia adenocarpa</i>		
<b>Asteraceae</b>	<i>Pteronia bolusii</i>		
<b>Asteraceae</b>	<i>Pteronia hutchinsoniana</i>		
<b>Asteraceae</b>	<i>Pteronia membranacea</i>		
<b>Asteraceae</b>	<i>Pteronia staehelinoides</i>		
<b>Asteraceae</b>	<i>Relhania sp.</i>		
<b>Asteraceae</b>	<i>Senecio achilleifolius</i>		

<b>Asteraceae</b>	<i>Senecio angustifolius</i>		
<b>Asteraceae</b>	<i>Senecio asperulus</i>		
<b>Asteraceae</b>	<i>Senecio burchellii</i>		
<b>Asteraceae</b>	<i>Senecio cordifolius</i>		
<b>Asteraceae</b>	<i>Senecio cotyledonis</i>		
<b>Asteraceae</b>	<i>Senecio hastatus</i>		
<b>Asteraceae</b>	<i>Senecio inaequidens</i>		
<b>Asteraceae</b>	<i>Senecio pinnulatus</i>		
<b>Asteraceae</b>	<i>Sonchus dregeanus</i>		
<b>Asteraceae</b>	<i>Taraxacum officinale</i>		
<b>Asteraceae</b>	<i>Tarchonanthus minor</i>		
<b>Asteraceae</b>	<i>Troglophyton capillaceum</i>	subsp.	<i>capillaceum</i>
<b>Asteraceae</b>	<i>Ursinia nana</i>	subsp.	<i>nana</i>
<b>Aytoniaceae</b>	<i>Plagiochasma rupestre</i>	var.	<i>rupestre</i>
<b>Bignoniaceae</b>	<i>Rhigozum obovatum</i>		
<b>Bignoniaceae</b>	<i>Rhigozum trichotomum</i>		
<b>Boraginaceae</b>	<i>Anchusa riparia</i>		
<b>Boraginaceae</b>	<i>Ehretia rigida</i>	subsp.	<i>rigida</i>
<b>Boraginaceae</b>	<i>Lithospermum scabrum</i>		
<b>Boraginaceae</b>	<i>Lobostemon stachydeus</i>		
<b>Boraginaceae</b>	<i>Trichodesma africanum</i>		
<b>Brassicaceae</b>	<i>Heliophila carnosa</i>		
<b>Brassicaceae</b>	<i>Heliophila crithmifolia</i>		
<b>Brassicaceae</b>	<i>Heliophila minima</i>		
<b>Brassicaceae</b>	<i>Heliophila sp.</i>		
<b>Bruniaceae</b>	<i>Audouinia esterhuyseniae</i>		
<b>Cactaceae</b>	<i>Cylindropuntia fulgida</i>		
<b>Cactaceae</b>	<i>Cylindropuntia imbricata</i>		
<b>Cactaceae</b>	<i>Opuntia ficus-indica</i>		
<b>Cactaceae</b>	<i>Opuntia microdasys</i>		
<b>Cactaceae</b>	<i>Opuntia sp.</i>		
<b>Cactaceae</b>	<i>Tephrocactus articulatus</i>		
<b>Campanulaceae</b>	<i>Wahlenbergia cernua</i>		
<b>Campanulaceae</b>	<i>Wahlenbergia nodosa</i>		
<b>Campanulaceae</b>	<i>Wahlenbergia sp.</i>		
<b>Campanulaceae</b>	<i>Wahlenbergia tenella</i>	var.	<i>tenella</i>
<b>Campanulaceae</b>	<i>Wahlenbergia undulata</i>		
<b>Capparaceae</b>	<i>Cadaba aphylla</i>		
<b>Caryophyllaceae</b>	<i>Cerastium capense</i>		
<b>Caryophyllaceae</b>	<i>Dianthus micropetalus</i>		
<b>Caryophyllaceae</b>	<i>Dianthus thunbergii</i>	forma	<i>thunbergii</i>
<b>Caryophyllaceae</b>	<i>Scleranthus sp.</i>		

<b>Caryophyllaceae</b>	<i>Silene burchellii</i>	subsp.	<i>pilosellifolia</i>
<b>Caryophyllaceae</b>	<i>Silene burchellii</i>	subsp.	<i>modesta</i>
<b>Caryophyllaceae</b>	<i>Silene undulata</i>		
<b>Colchicaceae</b>	<i>Colchicum melanthioides</i>	subsp.	<i>transvaalense</i>
<b>Colchicaceae</b>	<i>Colchicum melanthioides</i>		
<b>Colchicaceae</b>	<i>Colchicum striatum</i>		
<b>Colchicaceae</b>	<i>Ornithoglossum vulgare</i>		
<b>Convolvulaceae</b>	<i>Convolvulus sagittatus</i>		
<b>Crassulaceae</b>	<i>Adromischus humilis</i>		
<b>Crassulaceae</b>	<i>Cotyledon cuneata</i>		
<b>Crassulaceae</b>	<i>Cotyledon orbiculata</i>	var.	<i>orbiculata</i>
<b>Crassulaceae</b>	<i>Cotyledon orbiculata</i>	var.	<i>oblonga</i>
<b>Crassulaceae</b>	<i>Cotyledon papillaris</i>		
<b>Crassulaceae</b>	<i>Cotyledon sp.</i>		
<b>Crassulaceae</b>	<i>Crassula barbata</i>	subsp.	<i>barbata</i>
<b>Crassulaceae</b>	<i>Crassula capitella</i>	subsp.	<i>thyrsiflora</i>
<b>Crassulaceae</b>	<i>Crassula corallina</i>	subsp.	<i>corallina</i>
<b>Crassulaceae</b>	<i>Crassula cotyledonis</i>		
<b>Crassulaceae</b>	<i>Crassula expansa</i>	subsp.	<i>expansa</i>
<b>Crassulaceae</b>	<i>Crassula montana</i>	subsp.	<i>quadrangularis</i>
<b>Crassulaceae</b>	<i>Crassula muscosa</i>	var.	<i>muscosa</i>
<b>Crassulaceae</b>	<i>Crassula natans</i>		
<b>Crassulaceae</b>	<i>Crassula pubescens</i>	subsp.	<i>pubescens</i>
<b>Crassulaceae</b>	<i>Crassula rogersii</i>		
<b>Crassulaceae</b>	<i>Crassula rupestris</i>	subsp.	<i>rupestris</i>
<b>Crassulaceae</b>	<i>Crassula socialis</i>		
<b>Crassulaceae</b>	<i>Crassula tetragona</i>	subsp.	<i>tetragona</i>
<b>Crassulaceae</b>	<i>Crassula tomentosa</i>	var.	<i>tomentosa</i>
<b>Crassulaceae</b>	<i>Tylecodon reticulatus</i>	subsp.	<i>reticulatus</i>
<b>Crassulaceae</b>	<i>Tylecodon wallichii</i>	subsp.	<i>wallichii</i>
<b>Cucurbitaceae</b>	<i>Cucumis africanus</i>		
<b>Cucurbitaceae</b>	<i>Cucumis zeyheri</i>		
<b>Cyperaceae</b>	<i>Afroscirpoides dioeca</i>		
<b>Cyperaceae</b>	<i>Bulbostylis humilis</i>		
<b>Cyperaceae</b>	<i>Carex burkei</i>		
<b>Cyperaceae</b>	<i>Cyperus indecorus</i>	var.	<i>namaquensis</i>
<b>Cyperaceae</b>	<i>Cyperus longus</i>	var.	<i>tenuiflorus</i>
<b>Cyperaceae</b>	<i>Cyperus marginatus</i>		
<b>Cyperaceae</b>	<i>Cyperus textilis</i>		
<b>Cyperaceae</b>	<i>Cyperus usitatus</i>		
<b>Cyperaceae</b>	<i>Ficinia ramosissima</i>		
<b>Cyperaceae</b>	<i>Fuirena coerulescens</i>		

<b>Cyperaceae</b>	<i>Isolepis angelica</i>		
<b>Cyperaceae</b>	<i>Isolepis cernua</i>	var.	<i>cernua</i>
<b>Cyperaceae</b>	<i>Isolepis setacea</i>		
<b>Cyperaceae</b>	<i>Kyllinga pulchella</i>		
<b>Cyperaceae</b>	<i>Pseudoschoenus inanis</i>		
<b>Cyperaceae</b>	<i>Schoenoxiphium sp.</i>		
<b>Dipsacaceae</b>	<i>Scabiosa columbaria</i>		
<b>Ebenaceae</b>	<i>Diospyros austroafricana</i>	var.	<i>austroafricana</i>
<b>Ebenaceae</b>	<i>Diospyros austroafricana</i>	var.	<i>microphylla</i>
<b>Ebenaceae</b>	<i>Diospyros lycioides</i>	subsp.	<i>lycioides</i>
<b>Euphorbiaceae</b>	<i>Euphorbia braunsii</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia clavarioides</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia decepta</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia hypogaea</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia inaequilatera</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia mauritanica</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia patula</i>	subsp.	<i>patula</i>
<b>Euphorbiaceae</b>	<i>Euphorbia rhombifolia</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia spartaria</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia stellispina</i>		
<b>Euphorbiaceae</b>	<i>Euphorbia stolonifera</i>		
<b>Fabaceae</b>	<i>Argyrolobium argenteum</i>		
<b>Fabaceae</b>	<i>Argyrolobium sp.</i>		
<b>Fabaceae</b>	<i>Aspalathus acicularis</i>	subsp.	<i>acicularis</i>
<b>Fabaceae</b>	<i>Aspalathus divaricata</i>	subsp.	<i>divaricata</i>
<b>Fabaceae</b>	<i>Dichilus gracilis</i>		
<b>Fabaceae</b>	<i>Indigofera alternans</i>		
<b>Fabaceae</b>	<i>Indigofera alternans</i>	var.	<i>alternans</i>
<b>Fabaceae</b>	<i>Indigofera heterophylla</i>		
<b>Fabaceae</b>	<i>Indigofera meyeriana</i>		
<b>Fabaceae</b>	<i>Indigofera sessilifolia</i>		
<b>Fabaceae</b>	<i>Lessertia annularis</i>		
<b>Fabaceae</b>	<i>Lessertia frutescens</i>	subsp.	<i>frutescens</i>
<b>Fabaceae</b>	<i>Lessertia frutescens</i>	subsp.	<i>microphylla</i>
<b>Fabaceae</b>	<i>Lessertia inflata</i>		
<b>Fabaceae</b>	<i>Lessertia pauciflora</i>		
<b>Fabaceae</b>	<i>Lessertia sneeuwbergensis</i>		
<b>Fabaceae</b>	<i>Lotononis azureoides</i>		
<b>Fabaceae</b>	<i>Lotononis caerulea</i>		
<b>Fabaceae</b>	<i>Lotononis fruticoides</i>		
<b>Fabaceae</b>	<i>Lotononis laxa</i>		
<b>Fabaceae</b>	<i>Medicago laciniata</i>	var.	<i>laciniata</i>

<b>Fabaceae</b>	<i>Melolobium candicans</i>		
<b>Fabaceae</b>	<i>Melolobium canescens</i>		
<b>Fabaceae</b>	<i>Melolobium microphyllum</i>		
<b>Fabaceae</b>	<i>Melolobium sp.</i>		
<b>Fabaceae</b>	<i>Prosopis chilensis</i>		
<b>Fabaceae</b>	<i>Prosopis glandulosa</i>	var.	<i>glandulosa</i>
<b>Fabaceae</b>	<i>Prosopis velutina</i>		
<b>Fabaceae</b>	<i>Trifolium africanum</i>	var.	<i>africanum</i>
<b>Fabaceae</b>	<i>Vachellia karroo</i>		
<b>Frankeniaceae</b>	<i>Frankenia pulverulenta</i>		
<b>Fumariaceae</b>	<i>Cysticapnos pruinosa</i>		
<b>Funariaceae</b>	<i>Funaria spathulata</i>		
<b>Gentianaceae</b>	<i>Chironia palustris</i>	subsp.	<i>palustris</i>
<b>Gentianaceae</b>	<i>Sebaea pentandra</i>	var.	<i>pentandra</i>
<b>Gentianaceae</b>	<i>Sebaea sp.</i>		
<b>Geraniaceae</b>	<i>Erodium cicutarium</i>		
<b>Geraniaceae</b>	<i>Geranium dregei</i>		
<b>Geraniaceae</b>	<i>Geranium harveyi</i>		
<b>Geraniaceae</b>	<i>Monsonia crassicaulis</i>		
<b>Geraniaceae</b>	<i>Monsonia salmoniflora</i>		
<b>Geraniaceae</b>	<i>Pelargonium abrotanifolium</i>		
<b>Geraniaceae</b>	<i>Pelargonium althaeoides</i>		
<b>Geraniaceae</b>	<i>Pelargonium aridum</i>		
<b>Geraniaceae</b>	<i>Pelargonium brevirostre</i>		
<b>Geraniaceae</b>	<i>Pelargonium capituliforme</i>		
<b>Geraniaceae</b>	<i>Pelargonium denticulatum</i>		
<b>Geraniaceae</b>	<i>Pelargonium glutinosum</i>		
<b>Geraniaceae</b>	<i>Pelargonium griseum</i>		
<b>Geraniaceae</b>	<i>Pelargonium grossularioides</i>		
<b>Geraniaceae</b>	<i>Pelargonium laxum</i>	subsp.	<i>karooicum</i>
<b>Geraniaceae</b>	<i>Pelargonium laxum</i>	subsp.	<i>laxum</i>
<b>Geraniaceae</b>	<i>Pelargonium malacoides</i>		
<b>Geraniaceae</b>	<i>Pelargonium multicaule</i>	subsp.	<i>multicaule</i>
<b>Geraniaceae</b>	<i>Pelargonium myrrhifolium</i>	var.	<i>myrrhifolium</i>
<b>Geraniaceae</b>	<i>Pelargonium ramosissimum</i>		
<b>Geraniaceae</b>	<i>Pelargonium ribifolium</i>		
<b>Geraniaceae</b>	<i>Pelargonium senecioides</i>		
<b>Geraniaceae</b>	<i>Pelargonium sessiliflorum</i>		
<b>Geraniaceae</b>	<i>Pelargonium sidoides</i>		
<b>Geraniaceae</b>	<i>Pelargonium tetragonum</i>		
<b>Geraniaceae</b>	<i>Pelargonium tragacanthoides</i>		
<b>Gisekiaceae</b>	<i>Gisekia pharnaceoides</i>	var.	<i>pharnaceoides</i>



<b>Grimmiaceae</b>	<i>Grimmia laevigata</i>		
<b>Hyacinthaceae</b>	<i>Albuca exuviata</i>		
<b>Hyacinthaceae</b>	<i>Albuca namaquensis</i>		
<b>Hyacinthaceae</b>	<i>Albuca setosa</i>		
<b>Hyacinthaceae</b>	<i>Albuca sp.</i>		
<b>Hyacinthaceae</b>	<i>Albuca unifolia</i>		
<b>Hyacinthaceae</b>	<i>Albuca virens</i>	subsp.	<i>arida</i>
<b>Hyacinthaceae</b>	<i>Dipcadi viride</i>		
<b>Hyacinthaceae</b>	<i>Drimia intricata</i>		
<b>Hyacinthaceae</b>	<i>Drimia sp.</i>		
<b>Hyacinthaceae</b>	<i>Lachenalia aurioliae</i>		
<b>Hyacinthaceae</b>	<i>Lachenalia campanulata</i>		
<b>Hyacinthaceae</b>	<i>Ledebouria ensifolia</i>		
<b>Hyacinthaceae</b>	<i>Massonia depressa</i>		
<b>Hyacinthaceae</b>	<i>Massonia echinata</i>		
<b>Hyacinthaceae</b>	<i>Ornithogalum comptonii</i>		
<b>Hyacinthaceae</b>	<i>Ornithogalum flexuosum</i>		
<b>Hyacinthaceae</b>	<i>Ornithogalum hispidum</i>	subsp.	<i>hispidum</i>
<b>Hyacinthaceae</b>	<i>Ornithogalum juncifolium</i>	var.	<i>juncifolium</i>
<b>Hyacinthaceae</b>	<i>Ornithogalum paludosum</i>		
<b>Hyacinthaceae</b>	<i>Veltheimia capensis</i>		
<b>Hypoxidaceae</b>	<i>Empodium flexile</i>		
<b>Hypoxidaceae</b>	<i>Empodium gloriosum</i>		
<b>Iridaceae</b>	<i>Gladiolus permeabilis</i>	subsp.	<i>permeabilis</i>
<b>Iridaceae</b>	<i>Hesperantha bachmannii</i>		
<b>Iridaceae</b>	<i>Ixia marginifolia</i>		
<b>Iridaceae</b>	<i>Moraea ciliata</i>		
<b>Iridaceae</b>	<i>Moraea cookii</i>		
<b>Iridaceae</b>	<i>Moraea crispa</i>		
<b>Iridaceae</b>	<i>Moraea elliotii</i>		
<b>Iridaceae</b>	<i>Moraea polystachya</i>		
<b>Iridaceae</b>	<i>Moraea speciosa</i>		
<b>Iridaceae</b>	<i>Moraea unguiculata</i>		
<b>Iridaceae</b>	<i>Romulea atrandra</i>	var.	<i>esterhuyseniae</i>
<b>Iridaceae</b>	<i>Romulea macowanii</i>	var.	<i>macowanii</i>
<b>Iridaceae</b>	<i>Syringodea concolor</i>		
<b>Iridaceae</b>	<i>Tritonia laxifolia</i>		
<b>Juncaceae</b>	<i>Juncus acutus</i>	subsp.	<i>leopoldii</i>
<b>Juncaceae</b>	<i>Juncus exsertus</i>		
<b>Juncaceae</b>	<i>Juncus inflexus</i>		
<b>Juncaceae</b>	<i>Juncus scabriusculus</i>		
<b>Kewaceae</b>	<i>Kewa salsoloides</i>		

<b>Lamiaceae</b>	<i>Leonotis ocymifolia</i>		
<b>Lamiaceae</b>	<i>Mentha longifolia</i>	subsp.	<i>capensis</i>
<b>Lamiaceae</b>	<i>Salvia disermas</i>		
<b>Lamiaceae</b>	<i>Salvia stenophylla</i>		
<b>Lamiaceae</b>	<i>Salvia verbenaca</i>		
<b>Lamiaceae</b>	<i>Stachys cuneata</i>		
<b>Lamiaceae</b>	<i>Stachys dregeana</i>		
<b>Lamiaceae</b>	<i>Stachys linearis</i>		
<b>Lamiaceae</b>	<i>Stachys rugosa</i>		
<b>Lamiaceae</b>	<i>Teucrium africanum</i>		
<b>Lamiaceae</b>	<i>Teucrium trifidum</i>		
<b>Limeaceae</b>	<i>Limeum aethiopicum</i>	var.	<i>aethiopicum</i>
<b>Linaceae</b>	<i>Linum adustum</i>		
<b>Lobeliaceae</b>	<i>Lobelia dregeana</i>		
<b>Lobeliaceae</b>	<i>Lobelia sp.</i>		
<b>Lobeliaceae</b>	<i>Lobelia thermalis</i>		
<b>Loranthaceae</b>	<i>Moquiniella rubra</i>		
<b>Lythraceae</b>	<i>Nesaea anagalloides</i>		
<b>Malvaceae</b>	<i>Anisodonteia anomala</i>		
<b>Malvaceae</b>	<i>Anisodonteia capensis</i>		
<b>Malvaceae</b>	<i>Anisodonteia malvastroides</i>		
<b>Malvaceae</b>	<i>Anisodonteia sp.</i>		
<b>Malvaceae</b>	<i>Anisodonteia triloba</i>		
<b>Malvaceae</b>	<i>Grewia robusta</i>		
<b>Malvaceae</b>	<i>Hermannia althaeifolia</i>		
<b>Malvaceae</b>	<i>Hermannia burkei</i>		
<b>Malvaceae</b>	<i>Hermannia cernua</i>		
<b>Malvaceae</b>	<i>Hermannia coccoarpa</i>		
<b>Malvaceae</b>	<i>Hermannia comosa</i>		
<b>Malvaceae</b>	<i>Hermannia cuneifolia</i>	var.	<i>cuneifolia</i>
<b>Malvaceae</b>	<i>Hermannia cuneifolia</i>	var.	<i>glabrescens</i>
<b>Malvaceae</b>	<i>Hermannia desertorum</i>		
<b>Malvaceae</b>	<i>Hermannia filifolia</i>	var.	<i>grandicalyx</i>
<b>Malvaceae</b>	<i>Hermannia grandiflora</i>		
<b>Malvaceae</b>	<i>Hermannia linearifolia</i>		
<b>Malvaceae</b>	<i>Hermannia pulchella</i>		
<b>Malvaceae</b>	<i>Hermannia spinosa</i>		
<b>Malvaceae</b>	<i>Hermannia stricta</i>		
<b>Malvaceae</b>	<i>Hermannia vestita</i>		
<b>Malvaceae</b>	<i>Hibiscus pusillus</i>		
<b>Malvaceae</b>	<i>Hibiscus trionum</i>		
<b>Malvaceae</b>	<i>Malva pusilla</i>		

<b>Malvaceae</b>	<i>Radyera urens</i>		
<b>Marsileaceae</b>	<i>Marsilea burchellii</i>		
<b>Melianthaceae</b>	<i>Melianthus comosus</i>		
<b>Nyctaginaceae</b>	<i>Boerhavia cordobensis</i>		
<b>Ophioglossaceae</b>	<i>Ophioglossum polyphyllum</i>	var.	<i>polyphyllum</i>
<b>Orchidaceae</b>	<i>Eulophia hians</i>	var.	<i>nutans</i>
<b>Orchidaceae</b>	<i>Eulophia hians</i>	var.	<i>hians</i>
<b>Orchidaceae</b>	<i>Holothrix villosa</i>	var.	<i>villosa</i>
<b>Oxalidaceae</b>	<i>Oxalis pes-caprae</i>	var.	<i>pes-caprae</i>
<b>Oxalidaceae</b>	<i>Oxalis psilopoda</i>		
<b>Peraceae</b>	<i>Clutia marginata</i>		
<b>Peraceae</b>	<i>Clutia sp.</i>		
<b>Peraceae</b>	<i>Clutia thunbergii</i>		
<b>Plantaginaceae</b>	<i>Veronica anagallis-aquatica</i>		
<b>Poaceae</b>	<i>Agrostis lachnantha</i>	var.	<i>lachnantha</i>
<b>Poaceae</b>	<i>Aristida adscensionis</i>		
<b>Poaceae</b>	<i>Aristida congesta</i>	subsp.	<i>congesta</i>
<b>Poaceae</b>	<i>Aristida diffusa</i>	subsp.	<i>burkei</i>
<b>Poaceae</b>	<i>Aristida engleri</i>	var.	<i>engleri</i>
<b>Poaceae</b>	<i>Aristida junciformis</i>	subsp.	<i>junciformis</i>
<b>Poaceae</b>	<i>Aristida sp.</i>		
<b>Poaceae</b>	<i>Bromus catharticus</i>		
<b>Poaceae</b>	<i>Capeochloa arundinacea</i>		
<b>Poaceae</b>	<i>Cenchrus ciliaris</i>		
<b>Poaceae</b>	<i>Chaetobromus involucreatus</i>	subsp.	<i>dregeanus</i>
<b>Poaceae</b>	<i>Chloris virgata</i>		
<b>Poaceae</b>	<i>Cymbopogon dieterlenii</i>		
<b>Poaceae</b>	<i>Cymbopogon prolixus</i>		
<b>Poaceae</b>	<i>Cynodon dactylon</i>		
<b>Poaceae</b>	<i>Cynodon incompletus</i>		
<b>Poaceae</b>	<i>Digitaria argyrograpta</i>		
<b>Poaceae</b>	<i>Digitaria eriantha</i>		
<b>Poaceae</b>	<i>Ehrharta calycina</i>		
<b>Poaceae</b>	<i>Ehrharta erecta</i>	var.	<i>erecta</i>
<b>Poaceae</b>	<i>Ehrharta erecta</i>	var.	<i>natalensis</i>
<b>Poaceae</b>	<i>Ehrharta longigluma</i>		
<b>Poaceae</b>	<i>Enneapogon desvauxii</i>		
<b>Poaceae</b>	<i>Enneapogon scaber</i>		
<b>Poaceae</b>	<i>Enneapogon scoparius</i>		
<b>Poaceae</b>	<i>Eragrostis bergiana</i>		
<b>Poaceae</b>	<i>Eragrostis bicolor</i>		
<b>Poaceae</b>	<i>Eragrostis chloromelas</i>		

Poaceae	<i>Eragrostis cilianensis</i>		
Poaceae	<i>Eragrostis curvula</i>		
Poaceae	<i>Eragrostis homomalla</i>		
Poaceae	<i>Eragrostis lehmanniana</i>	var.	<i>lehmanniana</i>
Poaceae	<i>Eragrostis obtusa</i>		
Poaceae	<i>Eragrostis procumbens</i>		
Poaceae	<i>Eragrostis sp.</i>		
Poaceae	<i>Festuca scabra</i>		
Poaceae	<i>Fingerhuthia africana</i>		
Poaceae	<i>Fingerhuthia sesleriiformis</i>		
Poaceae	<i>Helictotrichon hirtulum</i>		
Poaceae	<i>Heteropogon contortus</i>		
Poaceae	<i>Hordeum murinum</i>	subsp.	<i>glaucum</i>
Poaceae	<i>Hordeum murinum</i>	subsp.	<i>leporinum</i>
Poaceae	<i>Hyparrhenia hirta</i>		
Poaceae	<i>Koeleria capensis</i>		
Poaceae	<i>Leptochloa fusca</i>		
Poaceae	<i>Melica decumbens</i>		
Poaceae	<i>Melica racemosa</i>		
Poaceae	<i>Melinis repens</i>	subsp.	<i>repens</i>
Poaceae	<i>Melinis repens</i>	subsp.	<i>grandiflora</i>
Poaceae	<i>Oropetium capense</i>		
Poaceae	<i>Panicum maximum</i>		
Poaceae	<i>Pennisetum setaceum</i>		
Poaceae	<i>Pennisetum sphacelatum</i>		
Poaceae	<i>Pentameris airoides</i>	subsp.	<i>jugorum</i>
Poaceae	<i>Pentameris airoides</i>	subsp.	<i>airoides</i>
Poaceae	<i>Pentameris setifolia</i>		
Poaceae	<i>Pentaschistis sp.</i>		
Poaceae	<i>Phalaris minor</i>		
Poaceae	<i>Phragmites australis</i>		
Poaceae	<i>Polypogon monspeliensis</i>		
Poaceae	<i>Polypogon sp.</i>		
Poaceae	<i>Polypogon viridis</i>		
Poaceae	<i>Schismus barbatus</i>		
Poaceae	<i>Setaria sphacelata</i>	var.	<i>torta</i>
Poaceae	<i>Setaria verticillata</i>		
Poaceae	<i>Sporobolus fimbriatus</i>		
Poaceae	<i>Sporobolus ioclados</i>		
Poaceae	<i>Sporobolus tenellus</i>		
Poaceae	<i>Stipagrostis ciliata</i>	var.	<i>capensis</i>
Poaceae	<i>Stipagrostis namaquensis</i>		

<b>Poaceae</b>	<i>Stipagrostis obtusa</i>		
<b>Poaceae</b>	<i>Stipagrostis uniplumis</i>	var.	<i>uniplumis</i>
<b>Poaceae</b>	<i>Tenaxia disticha</i>		
<b>Poaceae</b>	<i>Themeda triandra</i>		
<b>Poaceae</b>	<i>Tragus koelerioides</i>		
<b>Poaceae</b>	<i>Tragus racemosus</i>		
<b>Poaceae</b>	<i>Tribolium purpureum</i>		
<b>Poaceae</b>	<i>Urochloa panicoides</i>		
<b>Polygalaceae</b>	<i>Muraltia macrocarpa</i>		
<b>Polygalaceae</b>	<i>Polygala asbestina</i>		
<b>Polygalaceae</b>	<i>Polygala ephedroides</i>		
<b>Polygalaceae</b>	<i>Polygala leptophylla</i>	var.	<i>leptophylla</i>
<b>Polygalaceae</b>	<i>Polygala sp.</i>		
<b>Polygonaceae</b>	<i>Persicaria lapathifolia</i>		
<b>Polypodiaceae</b>	<i>Polypodium vulgare</i>		
<b>Pottiaceae</b>	<i>Pseudocrossidium crinitum</i>		
<b>Pteridaceae</b>	<i>Cheilanthes contracta</i>		
<b>Pteridaceae</b>	<i>Cheilanthes eckloniana</i>		
<b>Pteridaceae</b>	<i>Cheilanthes hirta</i>	var.	<i>hirta</i>
<b>Pteridaceae</b>	<i>Cheilanthes hirta</i>	var.	<i>brevipilosa</i>
<b>Pteridaceae</b>	<i>Cheilanthes induta</i>		
<b>Pteridaceae</b>	<i>Pellaea calomelanos</i>	var.	<i>calomelanos</i>
<b>Pteridaceae</b>	<i>Pellaea leucomelas</i>		
<b>Ptychomitriaceae</b>	<i>Ptychomitrium cucullatifolium</i>		
<b>Ranunculaceae</b>	<i>Clematis brachiata</i>		
<b>Ranunculaceae</b>	<i>Ranunculus multifidus</i>		
<b>Ranunculaceae</b>	<i>Ranunculus trichophyllus</i>		
<b>Rhamnaceae</b>	<i>Phyllica purpurea</i>		
<b>Rhamnaceae</b>	<i>Rhamnus prinoides</i>		
<b>Ricciaceae</b>	<i>Riccia albolimbata</i>		
<b>Ricciaceae</b>	<i>Riccia sorocarpa</i>		
<b>Rosaceae</b>	<i>Cliffortia arborea</i>		
<b>Rosaceae</b>	<i>Rubus ludwigii</i>	subsp.	<i>ludwigii</i>
<b>Rubiaceae</b>	<i>Anthospermum dregei</i>	subsp.	<i>dregei</i>
<b>Rubiaceae</b>	<i>Anthospermum sp.</i>		
<b>Rubiaceae</b>	<i>Anthospermum spathulatum</i>	subsp.	<i>spathulatum</i>
<b>Rubiaceae</b>	<i>Galium capense</i>	subsp.	<i>garipense</i>
<b>Rubiaceae</b>	<i>Galium capense</i>	subsp.	<i>capense</i>
<b>Rubiaceae</b>	<i>Galium tomentosum</i>		
<b>Rubiaceae</b>	<i>Nenax microphylla</i>		
<b>Salicaceae</b>	<i>Populus nigra</i>	var.	<i>italica</i>
<b>Santalaceae</b>	<i>Lacomucinaea lineata</i>		

<b>Santalaceae</b>	<i>Thesium hystrix</i>		
<b>Santalaceae</b>	<i>Thesium sonderianum</i>		
<b>Santalaceae</b>	<i>Viscum continuum</i>		
<b>Santalaceae</b>	<i>Viscum rotundifolium</i>		
<b>Scrophulariaceae</b>	<i>Aptosimum indivisum</i>		
<b>Scrophulariaceae</b>	<i>Aptosimum marlothii</i>		
<b>Scrophulariaceae</b>	<i>Aptosimum procumbens</i>		
<b>Scrophulariaceae</b>	<i>Aptosimum spinescens</i>		
<b>Scrophulariaceae</b>	<i>Buddleja glomerata</i>		
<b>Scrophulariaceae</b>	<i>Buddleja salviifolia</i>		
<b>Scrophulariaceae</b>	<i>Chaenostoma halimifolium</i>		
<b>Scrophulariaceae</b>	<i>Chaenostoma macrosiphon</i>		
<b>Scrophulariaceae</b>	<i>Chaenostoma pauciflorum</i>		
<b>Scrophulariaceae</b>	<i>Chaenostoma rotundifolium</i>		
<b>Scrophulariaceae</b>	<i>Chaenostoma sp.</i>		
<b>Scrophulariaceae</b>	<i>Cromidon decumbens</i>		
<b>Scrophulariaceae</b>	<i>Diascia alonsooides</i>		
<b>Scrophulariaceae</b>	<i>Diascia capsularis</i>		
<b>Scrophulariaceae</b>	<i>Hebenstretia parviflora</i>		
<b>Scrophulariaceae</b>	<i>Hebenstretia robusta</i>		
<b>Scrophulariaceae</b>	<i>Hebenstretia sp.</i>		
<b>Scrophulariaceae</b>	<i>Jamesbrittenia atropurpurea</i>	subsp.	<i>atropurpurea</i>
<b>Scrophulariaceae</b>	<i>Jamesbrittenia atropurpurea</i>		
<b>Scrophulariaceae</b>	<i>Jamesbrittenia sp.</i>		
<b>Scrophulariaceae</b>	<i>Jamesbrittenia tysonii</i>		
<b>Scrophulariaceae</b>	<i>Limosella grandiflora</i>		
<b>Scrophulariaceae</b>	<i>Limosella vesiculosa</i>		
<b>Scrophulariaceae</b>	<i>Nemesia cynanchifolia</i>		
<b>Scrophulariaceae</b>	<i>Nemesia fruticans</i>		
<b>Scrophulariaceae</b>	<i>Nemesia linearis</i>		
<b>Scrophulariaceae</b>	<i>Nemesia sp.</i>		
<b>Scrophulariaceae</b>	<i>Peliostomum leucorrhizum</i>		
<b>Scrophulariaceae</b>	<i>Selago albida</i>		
<b>Scrophulariaceae</b>	<i>Selago centralis</i>		
<b>Scrophulariaceae</b>	<i>Selago magnakarooica</i>		
<b>Scrophulariaceae</b>	<i>Selago rigida</i>		
<b>Scrophulariaceae</b>	<i>Selago saxatilis</i>		
<b>Scrophulariaceae</b>	<i>Selago sp.</i>		
<b>Scrophulariaceae</b>	<i>Trieenea glutinosa</i>		
<b>Scrophulariaceae</b>	<i>Zaluzianskya peduncularis</i>		
<b>Scrophulariaceae</b>	<i>Zaluzianskya venusta</i>		
<b>Solanaceae</b>	<i>Lycium cinereum</i>		

<b>Solanaceae</b>	<i>Lycium hirsutum</i>		
<b>Solanaceae</b>	<i>Lycium horridum</i>		
<b>Solanaceae</b>	<i>Lycium oxycarpum</i>		
<b>Solanaceae</b>	<i>Lycium pumilum</i>		
<b>Solanaceae</b>	<i>Lycium schizocalyx</i>		
<b>Solanaceae</b>	<i>Solanum capense</i>		
<b>Solanaceae</b>	<i>Solanum retroflexum</i>		
<b>Solanaceae</b>	<i>Solanum tomentosum</i>		
<b>Talinaceae</b>	<i>Talinum cafferum</i>		
<b>Thymelaeaceae</b>	<i>Gnidia meyeri</i>		
<b>Thymelaeaceae</b>	<i>Lasiosiphon deserticola</i>		
<b>Thymelaeaceae</b>	<i>Lasiosiphon polycephalus</i>		
<b>Thymelaeaceae</b>	<i>Lasiosiphon sp.</i>		
<b>Thymelaeaceae</b>	<i>Passerina corymbosa</i>		
<b>Thymelaeaceae</b>	<i>Passerina obtusifolia</i>		
<b>Typhaceae</b>	<i>Typha capensis</i>		
<b>Urticaceae</b>	<i>Forsskaolea candida</i>		
<b>Urticaceae</b>	<i>Urtica dioica</i>		
<b>Urticaceae</b>	<i>Urtica lobulata</i>		
<b>Urticaceae</b>	<i>Urtica urens</i>		
<b>Verbenaceae</b>	<i>Chascanum pumilum</i>		
<b>Verbenaceae</b>	<i>Lantana rugosa</i>		
<b>Zygophyllaceae</b>	<i>Roepera incrustata</i>		
<b>Zygophyllaceae</b>	<i>Roepera lichtensteiniana</i>		
<b>Zygophyllaceae</b>	<i>Tetraena chrysopteron</i>		
<b>Zygophyllaceae</b>	<i>Tetraena microcarpa</i>		
<b>Zygophyllaceae</b>	<i>Tribulus terrestris</i>		

## Appendix 3. Specialist CV.

# CURRICULUM VITAE:

## Gerhard Botha



**Name:** : Gerhardus Alfred Botha  
**Date of Birth** : 11 April 1986  
**Identity Number** : 860411 5136 088  
**Postal Address** : PO Box 12500  
Brandhof  
9324  
**Residential Address** : 3 Jock Meiring Street  
Park West  
Bloemfontein  
9301  
**Cell Phone Number** : 084 207 3454  
**Email Address** : [gabotha11@gmail.com](mailto:gabotha11@gmail.com)  
**Profession/Specialisation** : Ecological and Biodiversity Consultant  
**Nationality:** : South African  
**Years Experience:** : 8  
**Bilingualism** : Very good – English and Afrikaans

### **Professional Profile:**

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

### **Key Responsibilities:**

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans, compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.



## **Skills Base and Core Competencies**

- Research Project Management
- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.
- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

## **Education and Professional Status**

### ***Degrees:***

- 2015: Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- 2009: B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- 2008: B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

### ***Courses:***

- 2013: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.
- 2014: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

### ***Professional Society Affiliations:***

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

## **Employment History**

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd
- 2016 – November 2017: ECO-CARE Consultancy
- 2015 - 2016: Ecologist, Savannah Environmental (Pty) Ltd
- 2013 – 2014: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
  - Enviroworks (Pty) Ltd
  - GreenMined (Pty) Ltd
  - Eco-Care Consultancy (Pty) Ltd
  - Enviro-Niche Consulting (Pty) Ltd
  - Savannah Environmental (Pty) Ltd
  - Esicongweni Environmental Services (EES) cc
- 2010 - 2012: Enviroworks (Pty) Ltd

## **Publications**

### ***Publications:***

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. *S. Afr. J. Bot.*, **98**: 172-173.

### ***Congress papers/posters/presentations:***

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41<sup>st</sup> Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10<sup>th</sup> Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

## **Other**

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

## **References:**

- Christine Fouché  
Manager: GreenMined (Pty) LTD  
Cell: 084 663 2399
- Professor J du Preez  
Senior lecturer: Department of Plant Sciences  
University of the Free State  
Cell: 082 376 4404

**Appendix 4. Specialist’s Work Experience and References**

**WORK EXPERIENCES  
 &  
 References**



**Gerhard Botha**

**ECOLOGICAL RELATED STUDIES AND SURVEYS**

<b>Date Completed</b>	<b>Project Description</b>	<b>Type of Assessment/Study</b>	<b>Client</b>
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz

2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy
2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy
2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental
2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum-Kalahari-UNTU & 132kV Kathu IPP-Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshhoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshhoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshhoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental

2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental

2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom
2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORKX Renewables
2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected <i>Acacia erioloba</i> trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks
2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

## **WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS**

<b>Date Completed</b>	<b>Project Description</b>	<b>Type of Assessment/Study</b>	<b>Client</b>
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions

2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment)	Zevobuzz
2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental
2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

## **AVIFAUNAL ASSESSMENTS**

<b>Date Completed</b>	<b>Project Description</b>	<b>Type of Assessment/Study</b>	<b>Client</b>
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment)	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

## **ENVIRONMENTAL IMPACT ASSESSMENT**

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).
- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).
- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

## **ENVIRONMENTAL COMPLIANCE AUDITING AND ECO**

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for Envioworks (Pty) Ltd.).
- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Envioworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Envioworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Envioworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Envioworks (Pty) Ltd.).

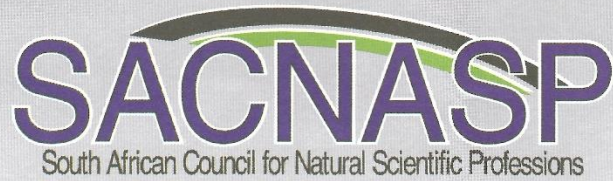
## **OTHER PROJECTS:**

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Envioworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Envioworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Envioworks (Pty) Ltd.)



- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair – Environmental Management Plan (for TWK Agricultural Ltd).

## Appendix 5. SACNASP CERTIFICATE



herewith certifies that

**Gerhardus Alfred Botha**

Registration number: 400502/14

is registered as a

**Professional Natural Scientist**

in terms of section 20(3) of the Natural Scientific Professions Act, 2003  
(Act 27 of 2003)  
in the following field(s) of practice (Schedule I of the Act)

**Ecological Science**

**28 January 2015**

**Botanical Science**

**19 November 2014**



28 January 2015

Pretoria

Handwritten signature of the President of SACNASP.

President

Handwritten signature of the Executive Director of SACNASP.

Executive Director

